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**THE TOTAL ARMY INJURY AND HEALTH OUTCOMES DATABASE (TAIHOD):
USES AND LIMITATIONS AS A RESEARCH TOOL FOR
FORCE HEALTH PROTECTION RESEARCH**

Nicole S. Bell¹
COL Paul J. Amoroso²
Laura Senier¹
Jeffrey O. Williams¹
Michelle M. Yore²
Ilyssa E. Hollander¹

¹Social Sectors Development Strategies, Inc.

²Military Performance Division
U.S. Army Research Institute of Environmental Medicine

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U.S. Army Research Institute of Environmental Medicine
Natick, MA 01760-5007

TABLE OF CONTENTS

List of Figures.....	v
List of Tables.....	v
Acknowledgments	vii
Contact Information.....	viii
List of Acronyms.....	viix
Executive Summary	1
Chapter 1: The TAIHOD Database.....	2
Introduction.....	2
The TAIHOD and Its Component Parts	3
Demographic and Occupational Data	4
Gulf War Activation Files.....	5
Inpatient Hospitalization Files	5
Ambulatory Care Encounters	7
Safety Center Data.....	7
Disability Data	8
Comprehensive Clinical Evaluation Program (CCEP).....	9
Health Risk Appraisal (HRA)	10
Health Enrollment Assessment Review (HEAR)	12
DMDC Survey of Active Duty Servicemembers	12
Army Casualty Information Processing System (ACIPS) Directorate for Information Operations and Reports (DIOR), and the Armed Forces Institute of Pathology (AFIP) Death Registry	12
Defense Occupational and Environmental Health Readiness System (DOEHRS)	13
Army Central Registry Child/Spouse Abuse Reporting System (ACR)	13
Aviation Epidemiology Data Registry (AEDR)	14
Airborne Jump School Data	14
Center for Unit Records Research (CURR)	15
Anthrax Vaccination Data.....	15
The Drug and Alcohol Management Information System (DAMIS) Database	16
Chapter 2: Force Health Protection Findings	17
Health Outcomes.....	17
Hospitalizations	17
Outpatient Visits	22
CCEP Registration	24
Deployment Activation Files	26
Injuries	27
Deaths.....	29
Risk Factors, Exposures, and Health Behaviors.....	29
The Health Risk Appraisal (HRA).....	29
Other Sources of Data on Stress	31
DMDC Surveys of Active Duty Soldiers	35
TAIHOD and VA Pilot Linkage Effort	36
Chapter 3: Research Resources: Strengths and Weaknesses of the TAIHOD and Other Linked Databases for Force Health Protection Research.....	38

Introduction.....	38
Challenges.....	38
Benefits.....	40
Chapter 4: Conclusions and Recommendations	43
Recommendations.....	43
References.....	45
Appendix A: HRA Survey (1992).....	53

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
1	Total Army Injury and Health Outcomes Database (TAIHOD)	4
2	Hospitalization rates for common disorders among CCEP registrants, and appendicitis among all active-duty Army Soldiers, 1971-1998	21
3	Number of inpatient hospitalizations and outpatient encounters for top 25 CCEP disorders, with ratio of outpatient to inpatient encounters, all active-duty Army Soldiers, 1998	23
4	Rates of inpatient hospitalizations for top 25 CCEP disorders at regional CCEP centers and other military medical facilities, among deployed and non-deployed Gulf War Era veterans, and key dates pertaining to provision of medical care for Gulf War veterans, 1991-1998	25
5	Potential explanations for the association between deployment and injury	28

LIST OF TABLES

<u>TABLE</u>		<u>PAGE</u>
1	Twenty-five conditions (other than “healthy”) most commonly reported by active-duty Army Soldiers registering with the Comprehensive Clinical Evaluation Program (CCEP), with their ICD-9-CM codes and corresponding codes from the ICD-9 and ICDA8 code books	19
2	Univariate and multivariate Cox Proportional Hazard Models: The influence of deployment and pre-war stressful life events on selected health outcomes of Gulf War era veterans, 1990-1993	33
3	Multivariate Proportional Hazard Models: Pre-war stressful life events, deployment, and post-war hospitalizations among enlisted Army Soldiers, 1990-1993	34
4	Changes in satisfaction between Soldiers who did and did not deploy to the Persian Gulf, as documented in selected items from the 1985 and 1992 DMDC occupational surveys	36

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APPENDIX A. CONTACT INFORMATION

For more information on the TAIHOD, or to contact our research staff, call or email us at:

CDR, USARIEM
ATTN: MCMR-EMP (Amoroso)
Kansas Street, Building 42
Natick, MA 01760-5007
(508) 233-4648

paul.amoroso@us.army.mil

LIST OF ACRONYMS

ACIPS	Army Casualty Information Processing System
ADS	Ambulatory Data System
AEDR	Aviation Epidemiology Data Repository
AFIP	Armed Forces Institute of Pathology
ASAP	Army Substance Abuse and Prevention
ASVAB	Armed Forces Vocational Aptitude Battery
AVA	Anthrax Vaccine Adsorbed
CCEP	Comprehensive Clinical Examination Program
CHCS	Composite Healthcare System
CRO	Carded for Record Only
CURR	Center for Unit Records Research
DAMIS	Drug and Alcohol Management Information System
DIOR	Directorate for Information Operations and Reports
DMDC	Defense Manpower Data Center
DOA	Dead on Arrival
DoD	Department of Defense
DOEHRs	Defense Occupational and Environmental Health Readiness System
EREC	Enlisted Records Center
GAO	Government Accounting Office
GWE	Gulf War Era
GWI	Gulf War Illness
HEAR	Health Enrollment Assessment Review
HRA	Health Risk Appraisal
ICD	International Classification of Disease
IPDS	Individual Patient Data System
MEB	Medical Evaluation Board
MEBBITT	Medical Evaluation Board Interim Tracking Tool
MOS	Military Occupational Specialty
MTF	Military Treatment Facility
OCR	Optical Character Recognition
ODS/DS	Operation Desert Shield/Desert Storm
OIF	Operation Iraqi Freedom
PASBA	Patient Administration Systems and Biostatistics Activity
PEB	Physical Evaluation Board
PTSD	Post-traumatic Stress Disorder
SSN	Social Security Number
STANAG	Standardization Agreement
TAIHOD	Total Army Injury and Health Outcomes Database
TDRL	Temporary Disability Retired List
USAMRAA	U.S. Army Medical Research Acquisition Activity
USAPDA	U.S. Army Physical Disability Agency
USARIEM	U.S. Army Research Institute of Environmental Medicine
VA	Veterans Administration

EXECUTIVE SUMMARY

The Total Army Injury and Health Outcomes Database (TAIHOD) is a research tool with great potential for identifying risk factors, documenting adverse health outcomes, and evaluating intervention strategies, among deployed and non-deployed active duty servicemembers. The TAIHOD comprises data from multiple Department of Defense agencies, including records of hospitalizations, outpatient visits, deaths, disabilities, flying duty medical examinations, accident reports, clinical evaluations from Gulf War registrants with the Comprehensive Clinical Evaluation Program (CCEP), and reports of spousal abuse, as well as demographic information, self-reported health behavior information from surveys, and occupational noise exposure data. The TAIHOD thus has great potential for Force Health Protection-related research focusing on the health of servicemembers during armed conflicts and during peacetime activities. Moreover, by virtue of the breadth and depth of the information it contains, it is particularly useful for assessing pre- and post-deployment health for the entire population of Soldiers serving on active duty.

This report describes the component databases of the TAIHOD, highlighting strengths and limitations of each of these data sources. This report also provides information in a “lessons learned” format in the hopes that this will make it particularly useful to other researchers who use some of the same data sources contained in the TAIHOD. We also provide data from our validation and data cleaning activities that not only highlight some of the pitfalls other researchers may wish to avoid when using these data, but also point to some potential areas for future research.

CHAPTER 1: THE TAIHOD DATABASE

INTRODUCTION

The TAIHOD is a large database linking multiple sources of administrative data and health records for all Army Soldiers who have been on active duty since 1971 (over 5 million individuals). A unique subject ID links data from one database component to another, but other information that could be used to identify a particular individual (e.g., name, Social Security Number [SSN]) is removed from the working datafiles. This method affords reliable linkage of a variety of records for the longitudinal study of the relationship between numerous health outcomes and a wide range of putative risk factors. Use of subject IDs, as well as stringent observation of human use protection guidelines and protection of data files allows this research to go forward while protecting the anonymity of individual Soldiers.

The TAIHOD was created in 1994 initially as a tool to facilitate the study of injuries among female Soldiers (8, 10). The TAIHOD structure and its component databases are described in greater detail later in this report. While initially developed for the study of injury in a subset of the Army population, it quickly became apparent that the TAIHOD also holds potential as a ready and powerful tool for the study of other types of health outcomes and for all members of the Army, as well as certain other components such as Army National Guard or Army Reserves.

This extended potential of the TAIHOD as a research tool became apparent when health concerns among Soldiers deployed to Operation Desert Shield/Desert Storm (ODS/DS) were identified concurrently with the realization that few existing data sources, besides the TAIHOD, contained health and behavior data on all Army Soldiers both before and after the war. Soon after ODS/DS, when Soldiers began returning to the United States, reports of unexplained illnesses began to surface. Many Soldiers attributed these illnesses to their service in the Gulf (41). Because the TAIHOD contains extensive data on health behavior and life-stress-related measures, as well as multiple health outcomes, the TAIHOD was identified as an important source of data that might clarify the role of stress and distress and other factors in the development of illnesses among deployed Gulf War Era (GWE) veterans and/or veterans of other conflicts.

In 1998 the TAIHOD team received funding from the U.S. Army Medical Research Acquisition Activity (USAMRAA) to conduct a pilot study to assess the utility of the TAIHOD as a deployment health research tool. The central purpose of this project was to evaluate the etiologic role stress and distress may play in the development of so-called Gulf War Illnesses (GWI). In the process, this project served as a pilot study to identify more general strengths and limitations of the TAIHOD as a tool for deployment health research.

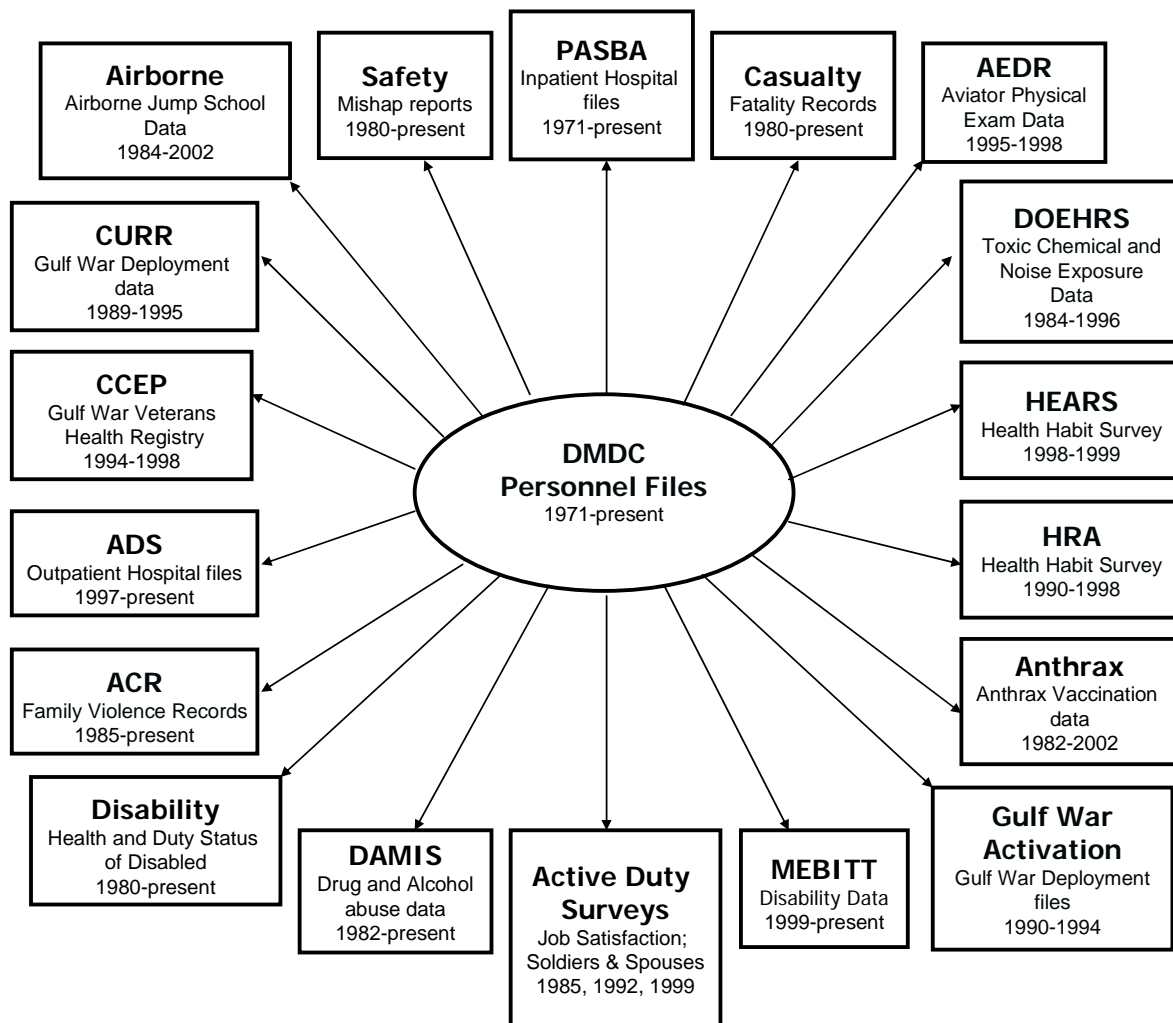
This report documents the strengths and limitations of the TAIHOD as a tool for Force Health Protection-related research with respect to different types of health

outcomes and various risk factors of importance to deployments and Force Health Protection in general (<http://www.ha.osd.mil/fhpr/default.cfm>). It reviews the challenges and obstacles we have faced in this work, suggests additional research questions that have grown out of our pilot work on Soldiers who served in ODS/DS, and makes recommendations for the collection and management of data that will enhance future efforts of this nature.

THE TAIHOD AND ITS COMPONENT PARTS

The TAIHOD contains extensive information on demographic and occupational histories of active duty Army Soldiers, records of inpatient hospitalizations, deaths, disability board evaluations, and ambulatory care visits (see Figure 1). It also includes data from the Comprehensive Clinical Examination Program (CCEP) of Gulf War veterans, coded data and narrative accounts of mishaps reported to the U.S. Army Safety Center, and various health behavior surveys, including the Army Health Risk Appraisal (HRA), the Health Enrollment Assessment Review (HEAR), and several Defense Manpower Data Center (DMDC) Surveys of Active Duty Servicemembers. The TAIHOD has recently acquired free text comment fields for hospitalizations related to injury, and extracts from the Army Central Registry (ACR) of documented reports of spouse and child abuse. An ambitious process of scanning hard copy physical evaluation board (PEB) disability records and the concomitant development of an electronic indexing and retrieval system for these records will also provide substantial detail for the study of disability among Army Soldiers. A recent collaborative effort with the Veterans Administration (VA) also brought in VA utilization and cost information.

Figure 1. The Total Army Injury and Health Outcomes Database (TAIHOD)



Demographic and Occupational Data

Demographic and occupational data in the TAIHOD are received from the DMDC in Monterey, CA (<http://www.dmdc.osd.mil>). These files contain basic demographic information such as date of birth, gender, race, educational attainment, ethnicity, rank, unit, marital status, military occupational specialty (MOS), and total time in service, for active duty as well as Army Reserve and Army National Guard Soldiers. (A complete list of variables in each database is available upon request.) These demographic variables are useful for defining and describing populations particularly at risk for certain adverse health outcomes. In addition, population demographic data are necessary for calculating population-based rates of morbidity and mortality and for controlling for confounding. Personnel data were reported annually between 1971 and 1979, but have

been updated in the TAIHOD semiannually for the years 1980-2002. Since, June 1, 2002, personnel files have been updated monthly.

In addition to core demographic data, the DMDC supplies information on various types of special pay received (e.g., special pay received for exposure to hostile fire or for specific Army duties such as parachuting, flying, or diving). Finally, loss files from the DMDC allow precise determination of each servicemember's length of service, with dates of entry into and separation from military service and reason for separation from service (e.g., retirement, misconduct, disability).

Gulf War Activation Files

The Gulf War Activation files were created after ODS/DS, in a post-hoc effort by the services to determine the deployment status of individual Soldiers. The files, maintained by the DMDC, give specific dates in and out of theater. Many Gulf War health researchers use these files. As we will discuss later in this report, there is some uncertainty about the quality of information in these files. A validation study of these files is currently underway.

Inpatient Hospitalization Files

Data on inpatient hospitalizations have been obtained from the Individual Patient Data System (IPDS), maintained by the Patient Administration Systems and Biostatistics Activity (PASBA) (<http://www.pasba.amedd.army.mil>). The TAIHOD currently contains information on all active-duty Soldiers who were hospitalized while on active duty from 1971 forward. If an active-duty Soldier is treated in a civilian hospital, the hospital is required to submit records to the military in order to receive reimbursement, so many hospitalizations of active duty Army Soldiers in civilian hospitals are also captured. However, changes in the way hospital data and care were managed beginning in 1996 may have affected the completeness of record capture by PASBA. We are currently investigating the potential extent of lost hospital records and exploring other sources of data on hospitalizations.

Hospital records contain demographic variables, up to eight International Classification of Disease (ICD) codes (for primary and subordinate diagnoses), cause-of-injury codes defined by a North Atlantic Treaty Organization Standardization Agreement (STANAG) if applicable, up to eight procedure codes, and total number of bed days. During the period of follow-up covered by the TAIHOD hospitalization files, the Army used three different versions of the ICD. From 1971-1979, they used ICD-A-8, then ICD-9 from 1980-1986, and ICD-9-CM since 1986. It is unlikely that all Army Medical Treatment Facilities (MTFs) made these transitions on exactly the same date, so we have found it necessary to exercise caution when querying the database for counts of hospitalizations around the time these changes were implemented. Moreover, each new version of the ICD introduces new codes for newly described clinical entities. Later in this report we will describe our efforts to use these data to construct a single coherent trend-line of Gulf War Illness (GWI) over this period.

Army hospitalization data also include essential information regarding injuries. Civilian hospital systems use the ICD system of E-codes, but the military uses the STANAG 2050 system instead. Unlike civilian hospitalization systems, where coding of injury causes is often incomplete and varies dramatically from state to state (40), the military system achieves a much higher rate of reporting cause of injury (5, 7). Military hospital records for injury cases also contain a text field that describe the circumstances of the injury and may be useful in exploring injury events in greater detail. These narrative data were recently added to the TAIHOD and currently cover a period from 1990 to 1999.

In addition to detailed information regarding hospitalizations, the inpatient files also contain Carded for Record Only (CRO) records. Historically, these records were created in order to track resources used to care for patients who were never admitted to the hospital (e.g., patients who were dead on arrival [DOA], or who died in the emergency room [ER]) and to facilitate surveillance of events of unique importance or interest (e.g., sexual assaults). Until 1996, CRO records were required on *all* emergency room or DOA deaths. Thus, it was possible to obtain cause-of-injury and/or free-text descriptions of the cause of injury for these deaths. Unfortunately, with the advent of the Ambulatory Data System (ADS), these records were considered unnecessary, because all encounters in the emergency departments are captured by ADS. Because ADS does not record cause-of-injury information, however, it is no longer possible to ascertain cause-of-injury on DOA cases or ER deaths, at least not using hospital data.

CRO records were also used to record Physical Evaluation Board (PEB) actions resulting in discharge from service for disability. Approximately two-thirds of the Soldiers who have been discharged from the Army since 1971 due to disability have CRO records in the hospital database. These records are a useful complementary data source to Army disability agency records. (Disability records will be described in greater detail in the sections that follow.) It is not clear why the remaining third of disability cases are missing CRO records, except that some of them appear to be cases that were found “fit” by the disability evaluation board (i.e., the Soldier was returned to duty). Although they do not represent admissions, CRO records provide important information, such as ICD-9-CM codes (which are not present in the physical disability database) and cause-of-injury codes. Unfortunately, as for DOA and ER deaths, the use of the CRO records for tracking disability cases has been phased out, thereby eliminating this source of information on disability cases. The emergence of the Medical Evaluation Board Interim Tracking Tool (MEBBITT) in 1999, however, is a promising development, and will yield a more complete source of information for the study of disability.

Another complexity in the use of hospitalization data relates to changes in the overall management of care. In the mid- to late 1990s, the military began increasing outsourcing of cases to civilian facilities through TRICARE, the military’s version of a managed care health plan for military servicemembers and their beneficiaries. Military reimbursement procedures had previously resulted in direct billing of care provided to an active duty servicemember to the MTF where care was provided. However, with the advent of TRICARE, some of these cases began being recorded elsewhere and are not

captured directly by PASBA's (IPDS). This change may result in underreporting hospitalizations after 1995. Of particular concern is that reporting may potentially vary by the type of condition or event (e.g., trauma, obstetric services) and potentially by location, especially in some areas that are served only by smaller MTFs, where a full complement of medical services may not be available. We expect to begin obtaining two additional databases that capture more of these outsourced cases in the future: the Civilian Health and Medical Program of the Uniformed Services and the Healthcare Services Record files. Further exploration will be needed to determine whether these databases, in combination with the IPDS, will capture all inpatient hospitalizations of active-duty Soldiers.

Finally, the TAIHOD includes records on special categories of patients. These include patients who use MTFs while on the Temporary Disability Retired List (TDRL). These patients are awaiting the results of a disability evaluation. (The disability records are described in greater detail in the sections that follow.) Another category includes "former active duty service members," such as women requesting discharges from the military under Chapter 8 (pregnancy). These patients are authorized to receive care in MTFs for a defined interval extending into the post-partum period.

Ambulatory Care Encounters

Through the ADS, PASBA has provided outpatient encounter records to the TAIHOD approximately twice a year since late 1997. These files contain up to four ICD-9-CM codes describing the reason for the encounter and up to four Current Procedural Terminology procedure codes. Data are now available for hundreds of thousands of outpatient encounters each year. Because the TAIHOD contains both diagnostic and procedure codes, we can evaluate the intensity of resource utilization, as well as severity of conditions. Unfortunately, STANAG cause-of-injury coding is not yet a feature of the ambulatory data collection system. However, in October 2000, the Department of Defense (DoD) approved plans to allow the use of ICD-9-CM E-codes in the ambulatory data. This will potentially allow cause of injury coding in the ADS without the necessity of major system changes to the ADS. However, the practical utility of this change cannot yet be evaluated because it depends upon providers to enter these additional codes, and it is not clear how completely providers will comply with this additional requirement. These data are expected to become more available as the Army's Composite Healthcare System (CHCS) is supplanted by CHCS-II, the new software to be used by providers in order to maintain electronic inpatient and outpatient data, and is fielded throughout the Military Health System.

Safety Center Data

The U.S. Army Safety Center receives reports on a portion of all unintentional injuries resulting in accidental death or serious injury, occupational illness, and property damage above certain thresholds (42) (<https://safety.army.mil/home.html>). Intentional injuries (e.g., homicide and suicide) and battle-related injuries are not included, nor are injuries that result in no lost time from work, or that incur neither lost time nor significant property damage. Safety Center data are updated in the TAIHOD annually for the years

1980-forward. The Safety Center data included in the TAIHOD comprise two parts: narrative accounts describing the circumstances under which the event occurred, and coded reports summarizing the event, both of which are completed by a representative of the injured Soldier's unit, or occasionally by a local safety office representative. The narrative reports may be as long as several pages or as short as several sentences; the level of detail is largely left up to the discretion of the individual completing the form. However, serious cases (e.g., those where a death occurred) almost always include a much greater level of detail than other cases, sometimes with several pages of accompanying text. Thus, there is a rich pool of data that could be used to better understand the nature and circumstances under which an injury event occurred. While substantial under-reporting is believed to be a characteristic of this database, its significant strength is the rich detail that is present on the cases that are reported, especially when linked to other databases.

Disability Data

The U.S. Army Physical Disability Evaluation process includes two review boards to evaluate a potentially disabled Soldier's medical status. The Medical Evaluation Board (MEB) assesses the degree of the Soldier's disability using medical standards (IAW AR 40-501), while the Physical Evaluation Board (PEB) assesses the impact of the disability on the Soldier's ability to perform his or her military duties (93) (<https://www.perscom.army.mil/tagd/pda/pdapage.htm>). These review boards may find a Soldier permanently disabled, or may find that he or she is fit to return to duty. If the Soldier's condition is temporary or unstable, the PEB may assign the Soldier to TDRL. (Such cases are re-evaluated at least every 18 months, and within 5 years must be given a final disposition.) Upon completion of the review process, the disabled Soldier may be retired permanently, or separated with or without severance pay. The TAIHOD includes all PEB records for the years 1981-forward, with information on dates of disability and the findings of the disability boards (including disability-rating percentages).

Interpreting disability data is particularly challenging because Soldiers placed on TDRL may remain in that status for up to 5 years before a final disposition is reached. Once defined as a TDRL case, the Soldier may later be found fit for duty, remain as a TDRL case, or be retired with or without a disability rating. Some of these individuals never return for re-evaluation, they just let their benefits run out and neither return to duty nor become permanently retired. The database contains multiple records pertaining to continuing evaluations, which reflect changes in the Soldier's disability status. Additionally, the PEB data do not include ICD-9-CM codes for medical conditions and, instead, use a less specific system known as the Veterans Administration System for Rating Disability.

MEB data from the Medical Evaluation Interim Tracking Tool (MEBBITT) were added to the TAIHOD in 2002. These data are available electronically only since 1999. The particular strengths of these data are that they allow ascertainment of cases at an earlier point in the disability rating process than the PEB database (MEBs always precede PEBs), and more individuals meet MEBs than PEBs, making more cases

available for study in the MEB database. Perhaps most importantly, MEB records contain ICD-9-CM diagnostic codes.

Several years ago, the TAIHOD data management team conducted a pilot project to obtain and scan a sample of 300 complete disability records (PEB) from 1997. The purpose of this project was to determine whether scanned images of these hard copy records could be indexed for later retrieval. Although time consuming, this pilot process was successful and has led to a larger effort to scan records from 1998-2000. The TAIHOD currently has some limited ability to retrieve text data and, in the future, is expected to have more extensive capabilities to retrieve narrative text (uncoded) information from the disability records based on some predetermined criteria (e.g., deployment status) so that the complete record may be reviewed. Disability records contain narrative summaries that are dictated by physicians, with extensive detail on the history of the present illness, past medical history, social history, and physical exam findings. The narrative accounts in the disability records are more voluminous in the level of detail they provide and are more structured than the narrative accounts available in hospital-based records. Narrative data have been useful to TAIHOD researchers and others in the study of a wide range of injury and disability outcomes (4, 24, 59, 74, 109). The potential of these data in furthering an understanding of natural history of injury and disability is therefore significant. We have since obtained more than 25,000 disability records from CY 1998-2000 and are gradually scanning them into the database (~4,000 to date). We recently came to an agreement with the Army Enlisted Records Center (EREC) and the U.S. Army Physical Disability Agency (USAPDA) to have these records scanned at EREC, including the remainder of the hard copy records maintained at the disability agency. Hard copy records for 2001 through October 2003 are still maintained by the USAPDA, though the agency began digitizing its files in October of 2003. Future enhancements using these scanned PEB files may include application of Optical Character Recognition (OCR) to eventually allow electronic analysis of the text contained in these documents. Pilot testing of OCR on the narrative summaries within these records looks particularly promising. We hope these efforts will form the foundation for comprehensive study of one of the most costly medical outcomes among Army Soldiers, that is, permanent disability. An Army STO to examine long-term health outcomes is now in the proposal stage.

Comprehensive Clinical Evaluation Program (CCEP)

In response to the concerns of Gulf War veterans that their service in the war had compromised their health, the DoD implemented the CCEP registry in 1994 for Soldiers still on active duty (66) (http://deploymentlink.osd.mil/faq/faq_ccep.shtml). (Veterans who had served in the Gulf War were eligible for health evaluations through the Veteran's Administration Persian Gulf Registry). Registry in the CCEP was voluntary, and included a clinical examination and survey of self-reported exposures to putative risk factors, such as pesticides, oil-well fire smoke, and vaccines and other prophylactic agents. The CCEP data include extensive information about the health of Soldiers who registered with this program. The clinical examination resulted in ICD-9-CM coded diagnoses for each participating servicemember. In many cases the diagnosis was "healthy," because servicemembers were encouraged to register if they deployed to the

Gulf, even if they did not yet have any symptoms. Many of the items on these surveys have potential utility for the pursuit of research questions unrelated to their initial purpose (e.g., data on tobacco use), and it is therefore possible that the CCEP data will be useful for a variety of studies of Soldier health.

Health Risk Appraisal (HRA)

The U.S. Army began offering the HRA in 1987 as part of a comprehensive health promotion program. While a precursor HRA survey that focused on cardiovascular health was also administered through the mid- and late 1980s, we have only been able to locate HRAs from ~1990 forward. The 1990 and 1992 versions of the HRA questionnaire include 75 items (see Appendix B, DA Form 5675, 1 February, 1992). Items 1-14 record basic demographic and administrative information (such as rank, branch of service, duty status, and unique identifying information such as name and SSN). Items 15-17 include self-reported anthropometric information on height, weight, and frame size. Items 70-75 gather clinical information (e.g., blood pressure, lipid levels, fasting glucose). The remaining items (items 18-69) form the core of the HRA and ask about health behaviors. Although HRAs are designed as educational and diagnostic tools and not to gather information for research purposes, the Army's HRA program, nonetheless, has yielded an enormous database of self-reported information about health habits that has proven quite useful for research purposes (23, 25, 27, 35, 47, 49, 83, 94, 98, 119, 124, 129). The Army's HRA includes a date field, allowing for the study of temporal associations between self-reported health habits and health outcomes. Moreover, a large number of Soldiers took the HRA more than once, allowing for the evaluation of changes in self-reported health behaviors, and an assessment of how these behavior changes may impact health. The TAIHOD maintains two separate databases of HRA data. The primary file contains HRA survey data taken by people who said they were active duty Army at the time they took the survey. The secondary file contains survey data of respondents without regard to how they described their service and military branch. All survey takers were matched to the DMDC personnel files, so all were active duty at some point, but not necessarily at the time they took the HRA.

These data have some limitations. First, the mechanism of administration was not entirely random. Soldiers who are young, single, and with a short time in active duty service are slightly over-represented among HRA takers. This is most likely the result of the administration process. The most common reason for taking an HRA is through in-processing to the military or a new assignment (27). Despite not being randomly distributed, differences between HRA takers and non-takers are very small.

Second, the health promotion program was implemented throughout the DoD, and retirees, dependent family members, and civilian employees sometimes also took the HRA. Dependent family members of military servicemembers are often required to use the servicemember's SSN to access military benefits, especially military medical benefits such as the HRA. It is therefore sometimes difficult to firmly establish whether the surveys being evaluated are those of an active duty servicemember, or those of a civilian employee, retiree, or family member. There are questions on the survey that

ask the respondent to identify himself as child, spouse, retiree, civilian employee, or active duty service member. However, these categories are not mutually exclusive and, where there was ambiguity, we resorted to comparing age and gender as reported on the HRA with age and gender on the DMDC personnel file.

Third, the HRA form in use during the time period for which data were archived was revised at least twice. (DA Form 5675 was originally issued in May 1988, then underwent a major revision in October 1990, and a much less substantial revision in 1992.) It is not known what instructions were given to people running the HRA at the installation level, but it is likely that existing supplies of forms may have been used before the newer versions were fully distributed. Unfortunately, the HRA database does not include a code indicating which version of the form the respondent was using. The 1988 version is so different from the 1990 and 1992 versions that data from that survey would not likely be mistaken with the other versions. Furthermore, no data we have been able to find appears to be derived from the 1988 version of the survey.

Fourth, we have found no evidence that the Army undertook any systematic efforts to assess the reliability and validity of responses to these questions. A technical report documenting what is known about the pedigree of the items on the HRA, and reviewing what is known about their reliability and validity in other contexts provides greater detail on these issues (105). An additional paper focuses on validation of the questions on the HRA that pertain to alcohol consumption (27).

Fifth, the HRA database contains a number of duplicate and near duplicate records. This may have occurred when a technician or health screener inadvertently or intentionally ran surveys through the scanning machine more than once if he or she thought the first survey did not register properly. It may also have occurred if, after scanning the document, the health assessment official noted missing items and asked the respondent to add more information before rescanning the survey. While it is easy to identify these records, it is not always possible to know which record should be kept from among a set of near duplicate records.

Sixth, the HRA survey program was designed to have the computer automatically add a date and time stamp to each survey datafile. Anecdotal evidence suggests that in early years of the HRA program, many computers used to process HRA surveys required manual updates of the date and time fields. It is likely that this effort was not uniformly applied across all Army computers resulting in unreliable dates for at least the first years of the program. Our own analysis and attempts to validate dates by cross-referencing with the respondents stated age and our demographic information on the respondents date of birth suggest that all surveys in the TAIHOD with dates preceding 1990 are probably not correctly dated.

The HRA remains an important source of useful information on health behaviors and risk factors, but depending on the question under investigation, investigators should use caution in analyzing HRA responses.

Health Enrollment Assessment Review (HEAR)

The HEAR is a self-reported survey examining health habits and utilization of the health care system (http://www.mqmc.af.mil/3rd/hear_PPIP.html). The HEAR replaced the HRA in 1998 and is to be administered to all members, ages 17 and older, of TRICARE Prime, the military health maintenance organization. Like the HRA, it queries respondents about health habits and behaviors, but unlike the HRA, its primary purpose is not health promotion or education. Its purpose is to identify patients who need preventive health care services, or who might benefit from counseling or health promotion interventions, and to predict the level of primary care a member will require. Its method of administration is also different; it was administered in its first several years by mail, but is being developed for administration via an interactive computer tutorial that will link the patient information directly to CHCS II. Although we have begun merging available 1998 and 1999 HEAR survey data (N = 43,377 surveys) with the TAIHOD, the HEAR has not yet been extensively evaluated with regard to data quality and sample representation. Because these surveys are administered and maintained by TRICARE region, there is still no single, central repository or site where all data are maintained and thereby easily accessed for research purposes. Since the regional TRICARE contracts to collect HEAR data have all recently ended, it is anticipated that all HEAR surveys collected to date may soon be consolidated and potentially available for study.

DMDC Survey of Active Duty Servicemembers

These surveys were administered to a statistically weighted random sample of military servicemembers in 1985, 1992, and 1999. They were originally developed in order to identify the changing needs of servicemembers and to guide the development of new policies. They cover a broad range of issues such as satisfaction with the military lifestyle, deployments, retention and career initiatives, dependent and childcare issues, military compensation, benefits and programs, and family resources. Of particular relevance to our research are several items within each of these categories that assess satisfaction with these various aspects of military life and capture information on associated levels of stress and distress. The 1992 version of this survey contains an item asking respondents if they were deployed to Operations Desert Shield/Desert Storm (ODS/DS) and is being used in a study to validate Gulf War deployment files.

Army Casualty Information Processing System (ACIPS) Directorate for Information Operations and Reports (DIOR), and the Armed Forces Institute of Pathology (AFIP) Death Registry

The Army's casualty database contains information on all fatalities occurring to active duty service personnel, whether job-related or not. They are obtained from the Report of Casualty form (DoD Form 1300), which is an abridged form of the civilian death certificate (http://www.defenselink.mil/privacy/notices/army/A0600-8-1c_AHRC.html, <http://web1.whs.osd.mil/DIORHOME.HTM>) The form includes deaths from both disease and injuries; the TAIHOD includes all records of such deaths from

1980 forward. However, it does not always include information regarding the specific external cause of death. A standardized extract of these data containing a limited number of fields is transmitted to the DIOR from each of the military services. ACIPS data were obtained for a limited time period in the mid-1990s and generally includes more information than the DIOR data, including several free text fields that may indicate details about activity and cause of injury. However, difficulties in obtaining the data directly from the Army Casualty Center and the recent addition of text fields to the DIOR may eliminate any future need to obtain data from ACIPS directly. Substantial data on deaths (including ICD-9-CM codes and cause-of-injury codes) may also be available by linking casualty reports to hospital CRO records or Safety Center accident reports. Hospital free-text data and Safety Center narratives can then be used to glean contextual details about the circumstances of the death. Another positive development is the recently established Armed Forces Institute of Pathology (<http://www.afip.org/Departments/repository/index.html>) (51) registry for active duty deaths. The registry will provide more accurate cause of death data because it will be collected from multiple sources including autopsies.

Defense Occupational and Environmental Health Readiness System (DOEHRS)

The Defense Occupational and Environmental Health Readiness System (DOEHRS) – formerly the Defense Occupational Health Readiness System – is the data warehouse devoted to documentation of environmental exposures such as noise, air quality, and various industrial chemicals. DOEHRS also contains serial audiograms collected through the Army Hearing Conservation Program (<https://dohrswwww.apgea.army.mil/dohrsdr/>).

Since the early 1980s, audiometric measures have been taken on more than 1 million individuals. Most Soldiers receive a baseline audiometry screening (documented in DD Form 2215) upon entry into the Army and are screened again upon leaving the service. Soldiers in units with high potential for noise exposure also receive annual hearing loss screening tests. Any changes from baseline or noted loss of function are reported on DD Form 2216. Data from both forms are entered in a database, and the information is then stored at the DOEHRS. Approximately 250,000 to 300,000 audiometry screenings (i.e., recent inductees and annual screenings) are recorded each year.

Additionally, hundreds of worksite noise and chemical exposure levels have been collected providing ecological data useful for estimating noise and chemical exposure levels for various Army occupational groups. Individual measurements are also available for many active duty Army personnel. The TAIHOD team has used them in one study examining the relationship of exposure to organic compounds and breast cancer (97). These data have not been updated nor used extensively by the TAIHOD research team, but could be, if needed.

Army Central Registry Child/Spouse Abuse Reporting System (ACR)

The Army Family Advocacy Program investigates, reports, and treats cases of abuse and neglect among family members of active duty Soldiers. A confidential registry of these cases has been maintained through the Army Central Registry (ACR) since 1975 (http://www.army.mil/usapa/epubs/pdf/r608_18.pdf)

(http://www.armycommunityservice.org/vacs_advocacy/home.asp) (84) Data include information about the victim and the offender, such as the nature and severity of the abuse, gender, date of birth, and race. In addition, the data state how the case was investigated, what steps were undertaken to resolve the problem, and the agency that provided the intervention. Cases are coded as one of five possible categories, including neglect, minor physical abuse, major physical abuse, sexual abuse, or emotional abuse. These data are the central focus of a grant from the National Institute on Alcohol Abuse and Alcoholism to study the relationship of alcohol use and spousal violence among Army Soldiers. They also have the potential to shed light on the influence of deployment-related stressors and subsequent risk of family violence in the post-deployment period.

Aviation Epidemiology Data Registry (AEDR)

The Aviation Epidemiology Data Repository (AEDR) is a family of independent databases maintained by the U.S. Army Aeromedical Research Laboratory (USAARL) (<http://www.usaarl.army.mil/>) and the U.S. Army Aeromedical Activity (<http://usasam.amedd.army.mil/AAMA/mission.htm>), both at Ft. Rucker, AL. One such component of the AEDR is a centralized database of history and physical findings from Army Flying Duty Medical Exams. These history and physical findings are used primarily to track trends in aviation medicine and also provide historical data such as waivers to standard medical qualifications. The history and physical exam data available from these annual exams is extensive. Because most aviators are required to have exams annually, serial exams are available on thousands of individuals. We received AEDR data for the first time in 2003. Because aviators are an important occupational group in the Army and because they face unique, often hazardous duty exposures, the addition of the AEDR strengthens the TAIHOD considerably as a tool for force health protection research.

Airborne Jump School Data

Airborne school roster data represent one of the few primary data collection efforts the TAIHOD team has pursued. The airborne school did not always maintain electronic records of individuals entering or completing Basic Airborne School (<http://usmilitary.about.com/gi/dynamic/offsite.htm?site=http://www.benning.army.mil/airborne/airborne/index.htm>). Several years ago, we came to an agreement with the Infantry School at Fort Benning to scan the paper rosters they had in their library going back as far as 1985. We then contracted to have the SSNs of these individuals entered into an electronic database so that we could study this population. Since 1985, over 225,000 individuals have enrolled in the Airborne school. Close to 1 million parachute jumps have been made over this 20-year period, making this the both the largest database of its kind and possibly the only such large database that is capable of

tracking characteristics and risk factors at the level of the individual. The fact that nearly all medical care for these individuals is issued at a single troop medical clinic or a single MTF (Martin Army Community Hospital) at Fort Benning makes it possible to do many unique and powerful analyses. The first such study compares injury hospitalization rates during intervals when parachute ankle braces were in use versus periods when they were not (104) (103). Additional studies underway will specifically compare injuries and other medical outcomes between women and men during this demanding training. Additional studies of the influence of Airborne training on various medical outcomes, career success, or other factors are also possible.

Center for Unit Records Research (CURR)

This database comes from the DoD Persian Gulf Registry. It consists of two files. The first is a personnel file consisting of Soldiers who were deployed to the Gulf between January of 1990 and March of 1992. The second is a unit movement file. The Persian Gulf registry personnel file is linked to the Army unit movement file by unit Identification Code. The personnel file contains many of the same variables found in the DMDC personnel files, in addition to “in theater” start date, and in theater end date. The unit movement file contains latitude and longitude, the date the location was reported, and a place name.

Anthrax Vaccination Data

The Defense Department’s Anthrax Vaccination Immunization Program is vital to the safety of U.S. military personnel. Since the inception of the program in March of 1998, more than 1,000,000 personnel have received at least one vaccination (up to a maximum of six). In the recent past, despite substantial evidence of the vaccine’s relative safety, questions have been raised and allegations made linking anthrax vaccination with a host of medical conditions. Several studies complete or underway are addressing these concerns. The TAIHOD was perhaps the only database that already had linkable data across the whole health care spectrum, including disability discharge. In November 2000 the Army Office of the Surgeon General asked the TAIHOD team to design and conduct a study to look for associations between anthrax immunization and disability discharge.

The TAIHOD was commissioned to undertake a study with the specific objective of examining whether U.S. Army personnel receiving one or more doses of Anthrax Vaccine Adsorbed (AVA) between March 1998 and February 2002 were at higher risk of disability than comparable personnel who were not vaccinated against anthrax. An historical cohort study of 716,833 active-duty Army personnel (154,456 vaccinated with AVA) was followed over 4.25 years to determine rates of evaluation for disability discharge. Cox proportional hazards models estimated the risk of evaluation for disability, comparing vaccinated with unvaccinated persons and accounting for occupational and sociodemographic characteristics that might be determinants of vaccination, risk of disability, or both. After adjustment for demographic and occupational characteristics, the overall hazard ratio (HR) was 0.96 (95% CI: 0.92, 0.99). Gender-specific adjusted HRs were 0.96 (95% CI: 0.92, 1.0) for men, and 1.04

(95% CI: 0.96, 1.13) for women. Separate adjusted HRs for permanent and temporary disability discharge, and for disability due to musculoskeletal and neurological conditions, were comparable to HRs for all disability evaluations, ranging from 0.90 to 1.04. The adjusted HR for disability evaluation was essentially unchanged when various latency assumptions were introduced into the model. This effort resulted in the conclusion that Army personnel vaccinated against anthrax are not at increased risk of disability, though that finding may be partially due to factors influencing selection for vaccination (115).

The Drug and Alcohol Management Information System (DAMIS) Database

In the fall of 2003 we acquired and began linking data from the DAMIS. This system, which operates under the Army's Substance Abuse and Prevention (ASAP) program, collects and reports data on the magnitude of drug and alcohol problems based on random and routine urine screening, as well as referrals for alcohol and drug treatment (self, command, or medical referrals). Local ASAP programs around the world complete standard reports (DA3711, DA4465, and DA4466) documenting positive drug and alcohol screens, referrals, and patient follow-up/progress. These records are linked to TAIHOD data in order to enhance information already available on alcohol use and abuse. The presence of these data in concert with extensive outcomes data, several sources of self-reported alcohol use, and abuse data (i.e., HRA) make the TAIHOD perhaps one of the most comprehensive sources for the study of the relationship between alcohol use and health outcomes.

CHAPTER 2: FORCE HEALTH PROTECTION FINDINGS

In this chapter we highlight some of the important findings related to Force Health Protection. The key findings are divided into sub-topics: Outcomes and Risk Factors. In addition, we identify and discuss strengths and weaknesses of the TAIHOD component databases as tools for Force Health Protection research.

HEALTH OUTCOMES

We have thus far used the following data sources on health outcomes in our research on deployment-related illnesses: inpatient hospitalizations, outpatient encounters, and registration with the CCEP. The TAIHOD also holds promise for the study of deployment-related deaths, disabilities, and injury morbidity, although it has not yet been fully exploited in the study of these conditions with respect to their association with deployment. We have used other databases contained in the TAIHOD for research important to the health and well-being of active duty Soldiers, but not specifically designed to address questions pertaining to deployment-health.

Hospitalizations

Because the TAIHOD includes data on deployment to ODS/DS and comprehensive hospitalization data, it is possible to compare the hospitalization histories of deployed and non-deployed GWE veterans both before and after the conflict. In addition, hospital data present in the TAIHOD extend from 1971 through the present allowing for the analysis of long-term trends in the “background rate” of hospitalizations common among Soldiers deployed to the Gulf.

While hospitalizations provide some of the most complete information we have about the health experiences of deployed veterans, they are not without limitations. Hospitalization databases are notoriously unreliable for capturing information on symptoms or poorly defined conditions that are diagnosed by clinical, rather than more empirical methods (e.g., fibromyalgia). Yet, many Soldiers who sought care presented these types of ill-defined, symptom-based conditions upon returning from ODS/DS (45, 48, 50, 57, 64, 72). Researchers have thus had to rely on proxy measures (e.g., defining cases as hospitalizations for an ICD-9-CM coded ill-defined condition) to measure health outcomes among deployed GWE veterans. Unfortunately, hospitalizations for ill-defined conditions are not very sensitive or specific indicators of these relatively minor, though chronic and potentially debilitating conditions.

In addition, hospitalization data may be a biased measure of baseline health, which may further limit their use in the study of the health of Gulf War veterans. We have found evidence of bias in at least four areas: (1) changes in the way in which conditions are assigned diagnoses, and in the way health care is delivered in general (e.g., temporal trends in hospitalization admission rates); (2) instrumentation bias (i.e., variable sensitivity of hospitalization for different diagnoses); (3) historical bias (e.g., associations between hospitalizations and events external to the war, such as media coverage of GWI and military downsizing); and (4) healthy worker effect (i.e., a greater

attrition rate among war veterans and VA care-seeking for previously unreported war-related health concerns). It should be noted that these biases are not limited to the TAIHOD and are a potential limitation to any study of GWE veteran's health that relies solely on hospitalization data. These potential biases have not been well documented in the literature, as they pertain to the use of administrative data sources and, in fact, are often ignored by researchers using administrative data in epidemiologic research. One of our goals has been to highlight these data limitations and to point out the potential influence of these sources of bias on research outcomes.

Some of our earliest work on health risks to Soldiers deployed during ODS/DS included an effort to document trends in hospitalizations for the 25 most common diagnoses (other than "healthy") among Gulf War veterans registered with the CCEP. We conducted this analysis over nearly three decades (1971-1998) to determine what the "background rate" of these conditions was among active-duty Army Soldiers prior to, during, and after the war. Because we were interested in comparative health we examined rates among Soldiers who were and who were not deployed to the Gulf. This analysis was possible only because the TAIHOD included hospitalization records spanning a long time period, but was challenging for many reasons. First, the Army used three different versions of the ICD classification system during the period of follow-up. Some of the conditions common among GWE veterans (e.g., post-traumatic stress disorder) did not exist in the ICD prior to Version 9 (see Table 1). Second, hospital admission practices have changed over time, and coding practices have evolved based on new research and medical guidelines. Finally, there have been changes in the way that medical care is delivered and how and where some hospitalization data are captured. Cost containment pressures have resulted in a system of managed care that tends to limit access to medical care providers and that favors treating patients on an outpatient basis in order to avoid costly hospitalizations altogether. To address changes occurring between versions of the ICD, we contracted with an expert nosologist to derive equivalent codes across the three different versions of the ICD in use by the Army during the follow-up period (ICDA8, ICD-9, and ICD-9-CM). For comparison purposes, we also plotted rates for appendicitis (ICD codes 540-543.99) as an example of a well-defined clinical condition whose code did not change over the study period. Appendicitis has consistently required at least a one-night hospitalization, and therefore would be expected to be unaffected by cost-containment pressures that may have resulted in many other patients being managed in an outpatient setting.

Table 1. Twenty-Five Conditions (Other Than “Healthy”) Most Commonly Reported by Active-Duty Army Soldiers Registering with the Comprehensive Clinical Evaluation Program (CCEP), with Their ICD-9-CM Codes and Corresponding Codes from the ICD-9 and ICDA8 Code Books

ICD-9-CM	% of Diagnoses	ICD-9-CM DEFINITION	ICD-9	ICDA8
290-319		Mental Disorders		
296.20	8.5%	Major depressive disorder, unspecified	296.1	296.0, 296.2
300.4	4.4%	Neurotic depression	300.4	300.0, 300.4
307.81	1.9%	Tension headache	307.8	306.8
309.81	1.9%	Prolonged post-traumatic stress disorder	N/A	N/A
311	7.4%	Depressive disorder, not elsewhere classified	311	790.2
320-389		Diseases of the Nervous System & Sense Organs		
346.90	2.0%	Migraine, unspecified	346.9	346
390-459		Diseases of the Circulatory System		
401.9	5.6%	Essential hypertension, unspecified	401.9	401
460-519		Diseases of the Respiratory System		
477.9	0.5%	Allergic rhinitis, cause unspecified	477.9	507
493.90	16.5%	Asthma, unspecified, without mention of status asthmaticus	493.90	305.2, 490, 493
520-579		Diseases of the Digestive System		
530.81	3.3%	Esophageal reflux	530.0, 530.1	530.9
564.1	2.9%	Irritable colon	564.1	305.5, 564.1
680-709		Diseases of the Skin and Subcutaneous Tissue		
692.9	1.5%	Contact dermatitis and other eczema, unspecified cause	692.9	692.9
710-739		Diseases of the Musculoskeletal System and Connective Tissue		
715.18	0.1%	Osteoarthritis, localized, other specified sites	715.18	N/A
715.90	0.5%	Osteoarthritis, unspecified, multiple sites	715.90	713.0, 723.9
719.40	0.2%	Pain in joint, site unspecified	719.40	787.3
719.46	7.9%	Pain in joint, lower leg	719.46	N/A
719.49	0.3%	Pain in joint, multiple sites	719.49	787.3
724.2	22.9%	Lumbago	724.2, 724.9	717.0, 717.9, 728.7
729.1	2.4%	Myalgia and myositis, unspecified	729.19	717.9, 733.9
780-799		Symptoms, Signs and Ill-Defined Conditions		
780.52	0.2%	Other insomnia	780.5	306.4
780.57	1.2%	Other and unspecified sleep apnea	N/A	N/A
780.7	1.0%	Malaise and fatigue	300.5, 780.7	300.5, 309.1, 790.1, 796.0
780.9	0.6%	Other general symptoms	300.9, 780.9	300.9, 780.7, 781.6, 788.9, 790.2
782.1	0.6%	Rash and other non-specific skin eruption	782.1	788.2
784.0	6.0%	Headache	784.0	791

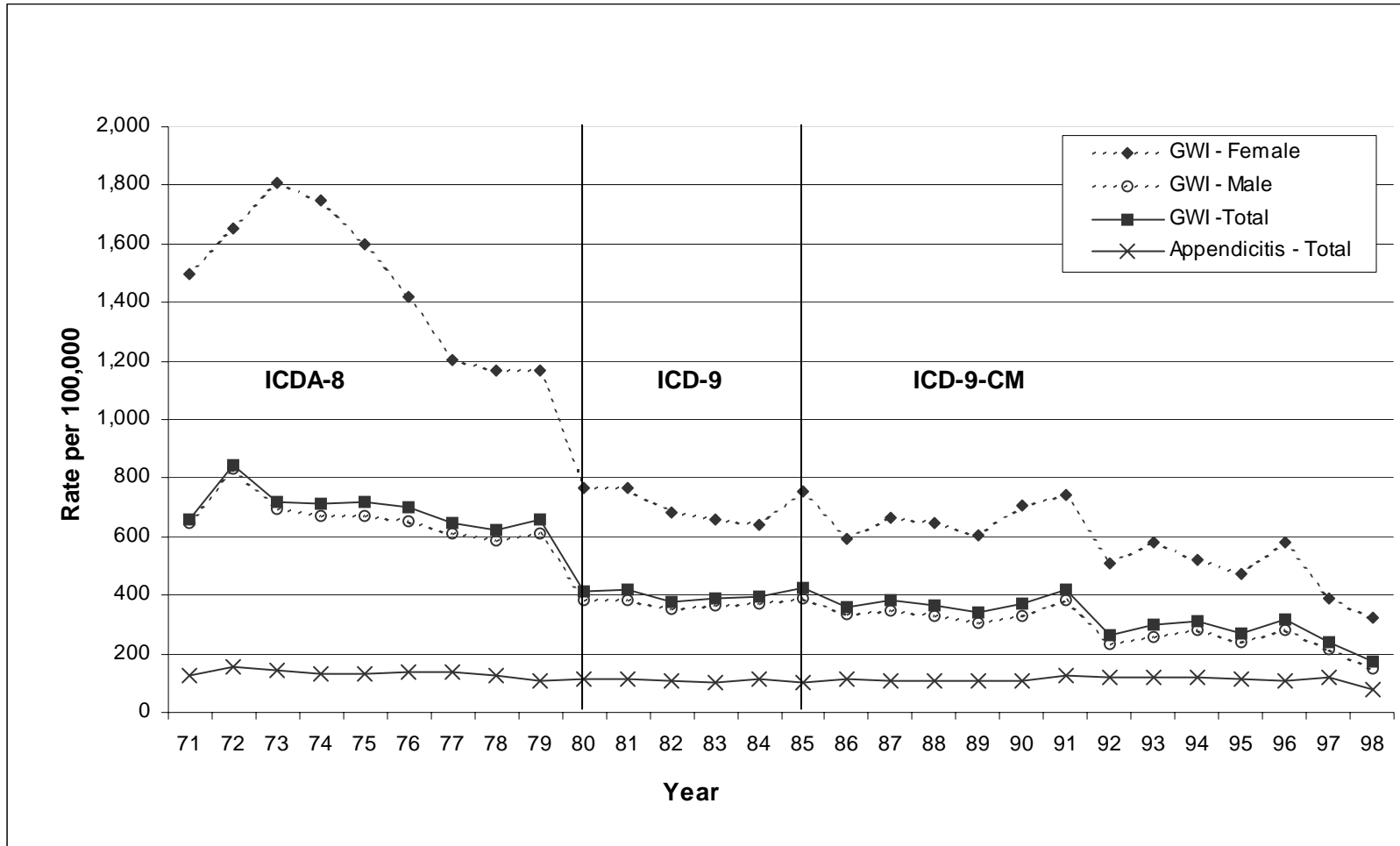
N/A=No prior code is applicable.

Figure 2 shows hospitalization rates for disorders common among CCEP registrants, as well as appendicitis rates (all active duty Army Soldiers, 1971-1998). The chart clearly demonstrates some of the technical challenges involved in a temporal analysis of this sort. As expected, hospitalization rates for appendicitis have remained fairly stable across the entire time period. Hospitalizations for conditions common among GW veterans registered with CCEP have declined over time from 658/100,000 in 1971 to 176/100,000 in 1998. While hospitalization rates overall appear to have declined, there were notable peaks in rates of these disorders in the early 1970s, and again just after the Gulf War in 1991. There were also several smaller increases in rates, generally preceding each major version change in the ICD. This suggests that changes in coding could affect analysis of temporal data, and researchers using hospital data for trend analysis need to be cognizant of this issue.

It is also noteworthy that although military tacticians and researchers have expressed concern that the exponential increase in the number and types of deployments during the 1990s may result in excess morbidity among deployed Soldiers, this chart suggests that rates for those conditions most common among deployed Gulf War veterans either did not increase dramatically during this time period, or were not captured by hospitalization databases. It may be that there was no increase in rates for these conditions among Soldiers involved in other deployments after ODS/DS. On the other hand, it might reflect the fact that other deployments after the ODS/DS were too small to have had a meaningful impact on Army hospitalization rates for these conditions. Additionally, hospitalizations may be insensitive indicators of the health problems associated with deployment. Changes in recent hospitalization admission practices or incomplete capture of the data make them inadequate, at the present time, for analyses of this sort.

Our efforts to map trends in GWI over a 30-year period reflect both the strengths and limitations of this type of research. The manner in which we identified codes in prior editions of the ICD may have introduced some misclassification, especially when some conditions were grouped or ungrouped in different versions of the ICD, or when codes were introduced for “new” conditions. For example, post-traumatic stress disorder (PTSD) had no formal code or definition prior to ICD-9. The exclusion of this condition from the combined list of top 25 CCEP diagnoses may have biased the overall hospitalization rates downward in the early years of the chart. In contrast, in other cases, conditions with unique codes under ICD-9 were grouped with other codes under ICDA8 because they could not be disentangled. This may have resulted in an upward bias in rates for earlier years. While we made an effort to account for coding changes, it is most conservative to make comparisons within time periods that are covered by the same coding system. Thus, while we can conclude that overall rates were declining over time by examining downward trends that occurred during each of the three intervals covered by the different ICD versions, an absolute comparison between rates in 1971 and 1998 would be inadvisable.

Figure 2. Hospitalization rates for common disorders among CCEP registrants, and appendicitis among all active-duty Army Soldiers, 1971-1998



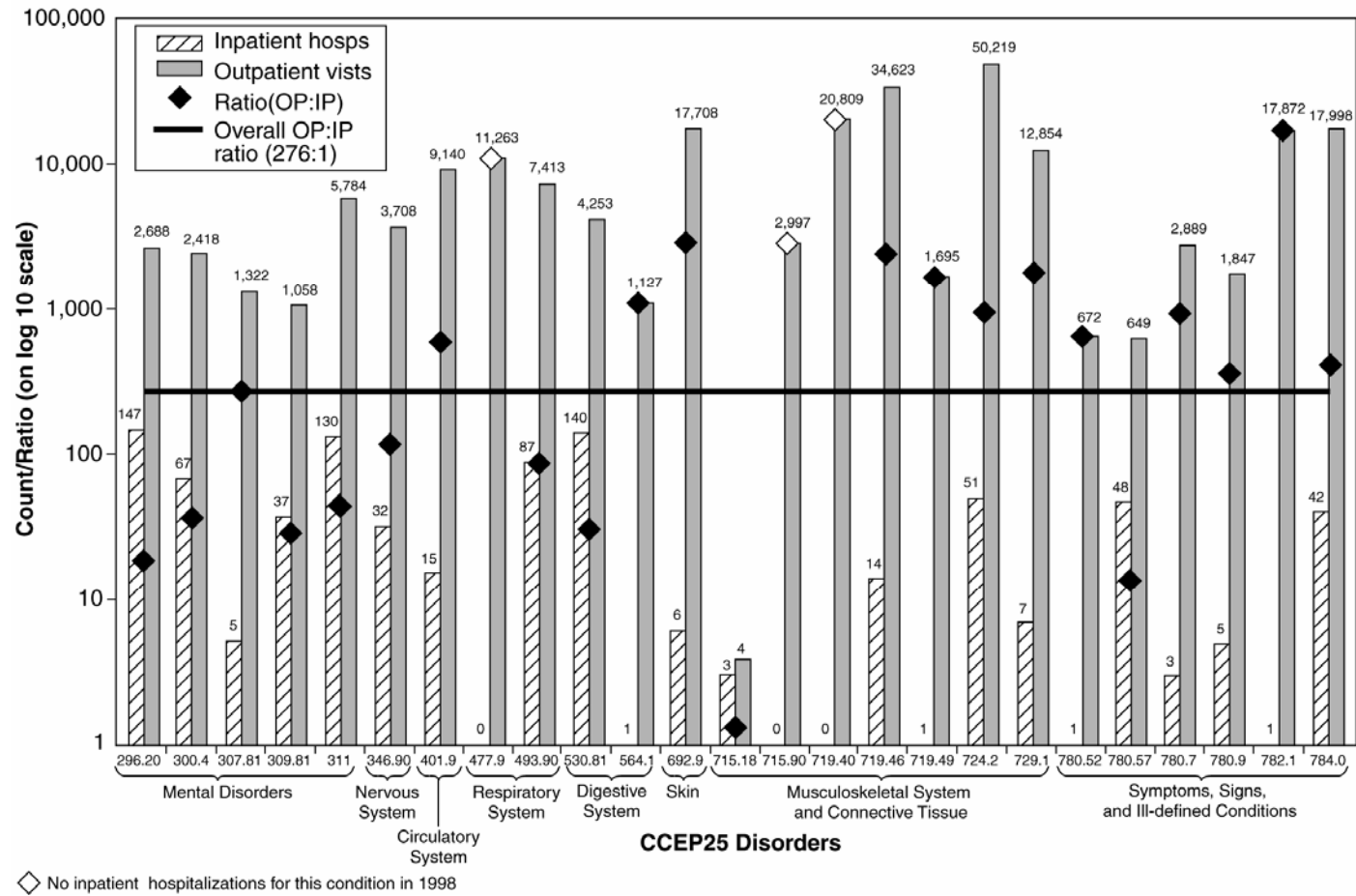
Outpatient Visits

We have begun exploring outpatient data as a tool for evaluating the influence of deployment on health. In fact, the symptom-based conditions that plagued many deployed GWE veterans are disabling, yet typically less than life threatening, and thus were often treated in outpatient settings such as clinics or physician's offices. However, electronic information on outpatient encounters was not available until late 1997, and we were therefore limited in our ability to fully examine the outpatient utilization histories for Gulf War veterans in the immediate post-war era. This is a significant limitation not only for researchers using the TAIHOD, but also for other researchers in this field. Many other published studies have therefore focused instead on the only consistently available data spanning the critical time period: inpatient hospitalizations (23, 53, 56, 70, 73). In addition to problems exploring hospitalization trends that were described above, there are other limitations relevant to the decision to use hospitalizations as a proxy for all morbidity.

If the cases that resulted in hospitalization for both deployed and non-deployed GWE veterans were those that were most severe regardless of diagnosis, then using hospitalizations alone as a proxy measure for all such conditions might result in a realistic picture of the overall condition-specific morbidity among GWE veterans. If, however, some conditions were more likely to result in hospitalization regardless of severity, then the resulting picture of morbidity among deployed GWE veterans is likely to be skewed toward these conditions. Most troubling is the possibility that certain conditions may be more likely to result in hospitalization based on a Soldier's deployment status (e.g., deployed versus non-deployed), branch of service (e.g., Army versus Navy), duty status (e.g., active duty, Guard, or Reserve), or time spent in the Gulf (e.g., dates or duration of deployment).

Our research suggests, in fact, that hospitalizations do not provide a very good representation of all types of morbidity among deployed GWE veterans. In our comparison of inpatient and outpatient rates for conditions common among deployed GWE veterans for calendar year 1998 (the first full year for which data on outpatient encounters are available in electronic format), we found that ratios of hospitalizations to ambulatory care visits varied markedly by condition (see Figure 3). Using hospitalization data alone to quantify symptom-based illnesses is likely to undercount all conditions, and to do so in different proportions for certain individual diagnoses and broad diagnostic categories. Therefore, hospitalization data may be very powerful in detecting increases in some conditions (e.g., psychiatric disorders) while overlooking others (e.g., musculoskeletal conditions). This might lead researchers to undervalue the true burden of morbidity presented by certain conditions, or to overestimate the relative contributions toward morbidity from other conditions.

Figure 3. Number of inpatient hospitalizations and outpatient encounters for top 25 CCEP disorders, with ratio of outpatient to inpatient encounters, all active-duty Army Soldiers, 1998



This limitation of the TAIHOD with regard to studies of post-deployment health will become less relevant with the investigation of more recent deployments, as outpatient data have been available in electronic form since 1998. Despite the availability of better outpatient data, however, researchers must remember that comparisons between inpatient and outpatient rates will necessarily be incomplete unless all inpatient encounters from all outsourced facilities (e.g., TRICARE) and all outpatient encounters (such as Battalion Aid Stations) are captured. Moreover, ICD-10-CM will be coming on-line eventually, which means that researchers will need to wrestle yet again with changes in coding systems and changes in medical practices.

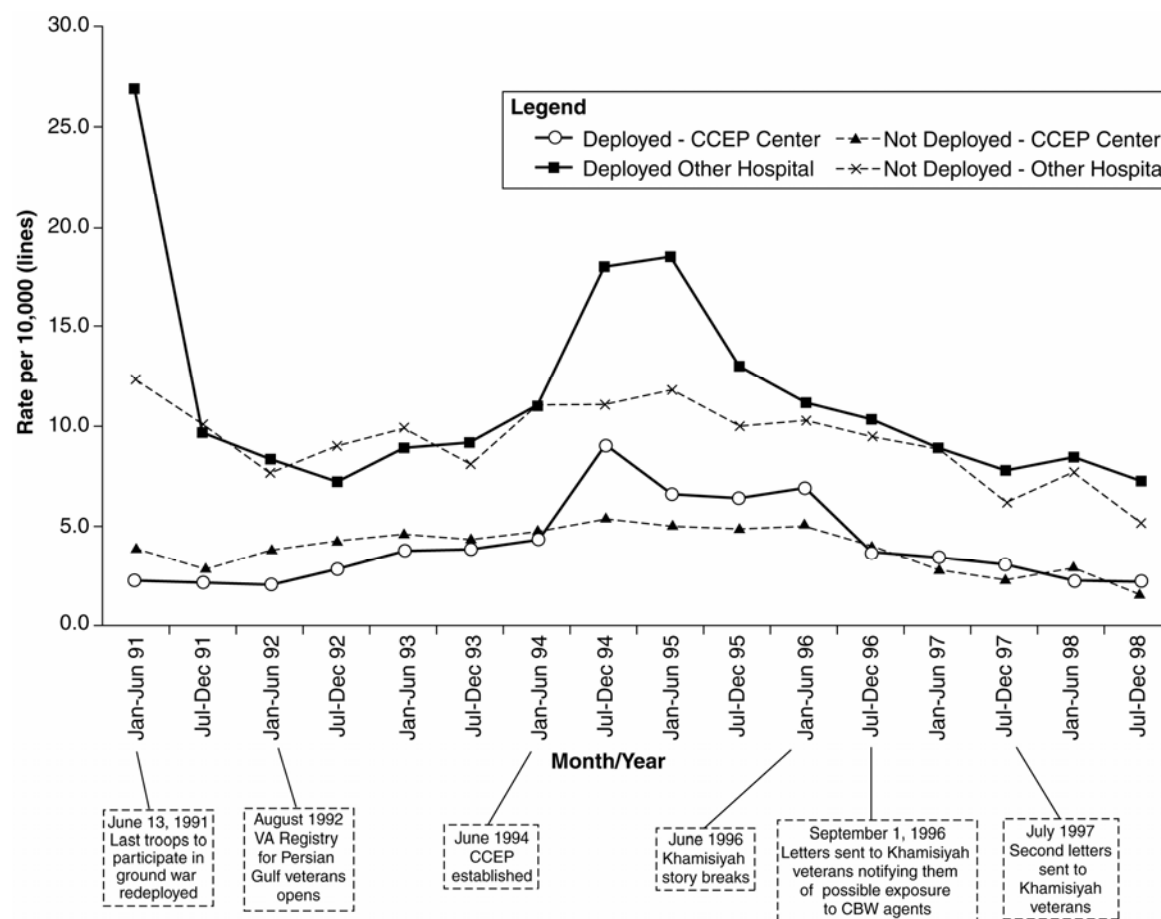
CCEP Registration

Post-deployment health registries, such as the CCEP, provide another source of information both on exposures and health outcomes. The CCEP has been utilized in Gulf War-related research (1, 66). However, the CCEP data are somewhat limited because registration in the CCEP was voluntary, resulting in self-selection bias. It is also noteworthy that most Soldiers who registered with the CCEP were found to be healthy. Moreover, a large proportion of CCEP registrants were found to have conditions commonly found in any large population (e.g., hypertension), which may occlude the significance of important findings (especially instances of rare conditions).

In addition, the CCEP program itself, and the related exams, may have resulted in artificially inflated hospital admission rates, thus making studies of hospitalization outcomes among GW veterans less valuable. For example, it is possible that the extensive clinical evaluations required under the program may have caused some referral centers to hospitalize deployed veterans for logistical reasons rather than medical necessity, potentially resulting in artificially inflated hospital admissions among deployed veterans. Moreover, the awareness of the creation of these health registries may have caused veterans suffering from conditions *not* related to deployment to attribute their symptoms to the war. That is, the war or other deployment-related experiences may have provided a “focalizing point” for Soldiers suffering from various conditions (18). To evaluate the potential impact of CCEP program administrative actions on rates of hospital admissions, we compared admission rates for diagnoses common among CCEP registrants in facilities designated as regional CCEP centers to rates of these conditions in other MTFs (Figure 4). If there were a bias related to CCEP administration, we expected to observe an increase in rates of admission in CCEP facilities that was not mirrored in other MTFs. Though the increased rates in 1994 were most pronounced among deployed Gulf War Era Soldiers, non-deployed Gulf War Era Soldiers also experienced slight increases in admissions for CCEP25 disorders during this time period in both types of facilities. Boxes below the figure show dates of administrative events related to the war and the Army’s response to the health concerns of Gulf War Era veterans. The most noticeable peak in hospitalization rates occurred just after the CCEP was established. While trends in rates for CCEP25 disorders generally maintained a consistent decline after June 1996, there was a small peak among deployed Soldiers who sought care in non-CCEP facilities the second time letters were sent out informing deployed Soldiers that destruction of an Iraqi munitions

depot may have exposed US troops to trace levels of nerve agents. Interestingly, increases were also observed among nondeployed soldiers after the date the letters were sent out suggesting that either there were other factors influencing rates of illness during this time period that may affect both deployed and nondeployed soldiers; or that there may be a normative effect such that increased awareness of conditions and symptoms affected health seeking behavior among both deployed AND nondeployed soldiers.

Figure 4. Rates of inpatient hospitalizations for top 25 CCEP disorders at regional CCEP centers and other military medical facilities, among deployed and non-deployed Gulf War Era veterans, and key dates pertaining to provision of medical care for Gulf War veterans, 1991-1998



In addition to the limitations described above, we have uncovered some other data quality problems in the CCEP registry data, some of which may have been inadvertently introduced by the administrators of the CCEP database. Registration in the CCEP included a clinical examination and the completion of a comprehensive survey on exposure to hypothesized stressors in the war zone (e.g., chemical or biological warfare agents, vaccines). This questionnaire included an item that queried respondents specifically on whether or not they served in the Gulf War (item #122). Managers of the CCEP database unfortunately made an administrative decision to delete this item, as they believed a response to any of the items asking about specific exposures in the Gulf was indicative of having been actually deployed. It is a truism in survey research, however, that no matter how carefully the skip instructions in a questionnaire have been constructed, there will be some proportion of respondents who will inappropriately skip or answer items that do not apply to them (38). The administrative decision to eliminate the responses to this question has limited our ability to evaluate these data for quality and completeness.

In addition, this decision has limited our ability to conduct validation studies to assess the accuracy of deployment (activation) data. If the response to the CCEP questionnaire item had been left in the database, we could have more easily (and perhaps more accurately) compared the responses on that item to information in the Gulf War deployment activation file in order to develop more precise estimates of the extent of misclassification bias in the activation file. (Our efforts to explore the validity of the information in the Gulf War activation files are described in more detail in the section that follows.) One of the most important contributions the TAIHOD team can make is in communicating its experiences with administrative data back to the Army agencies that collect the data and suggest ways to facilitate better data collection that will make high-quality and cost-efficient epidemiologic research possible.

Deployment Activation Files

The TAIHOD includes records from the DMDC on deployment to ODS/DS. While deployment status is a key piece of information for the assessment of the health of GWE veterans, exploration and use of these data have raised concern about their overall accuracy. Because the TAIHOD comprises a conglomeration of secondary data files, we cannot directly control the accuracy or the reliability of the data we receive. We must, however, evaluate the quality of the data we receive before using it in epidemiologic research, and we have begun to explore the overall quality, completeness, and potential biases of the Gulf War deployment activation datafiles.

After the Gulf War ended, the services did their best to create files that identified Soldiers who were deployed to the conflict. These files were subsequently used by many researchers, ourselves included, to conduct epidemiologic studies of Gulf War Illnesses (GWI) (12, 13, 23, 28, 39, 43, 53-56, 67-71, 108, 110-114, 117, 127). To date, there have not been any published studies systematically evaluating the quality of these data. Several researchers have noted anomalies in these files, however. Steele and her co-investigators on the Kansas Persian Gulf War Veterans Health Initiative

Program reported an overall discordance between self-reported deployment status and military personnel records of approximately 7% (111). This degree of misreporting seemed, however, to vary among the study groups; 15% of the GWE veterans, whose DMDC records indicated that they had not gone to the Gulf, reported that they were in fact there. In a separate study of Gulf War veterans in the Pacific Northwest, McCauley et al. found that 8.5% of the Soldiers who had deployment status records in the DMDC files reported that they had not actually deployed (86). Anecdotal evidence from some of these veterans suggested that although their unit had been deployed, circumstances had occurred that prevented them from being deployed with their unit. In a follow-up study, McCauley et al. contacted a sample of Gulf War veterans from the Pacific Northwest by telephone to interview them about their experiences. To their surprise, 274 (9%) reported that they were not on active duty in either the Army or National Guard during the war, and another 231 (8%) reported that they were veterans of prior conflicts (e.g., Vietnam), but that they had not participated in ODS/DS (87). Finally, in testimony before the Senate Committee on Veterans' Affairs, Stephen P. Backhus noted that these shortcomings in accurately capturing deployment status continued to be problematic in subsequent deployments (14). Dr. Backhus noted that DMDC records for Operation Joint Endeavor did not include records for 200 Navy sailors who had truly deployed to Bosnia, and that it incorrectly included records for Air Force personnel who had never deployed. Furthermore, Dr. Backhus pointed out that although an Institute of Medicine report had recommended that the DoD implement a system for tracking movement of service members within the theater of operations, this recommendation had not been implemented in sufficient time to be used for Operation Joint Endeavor.

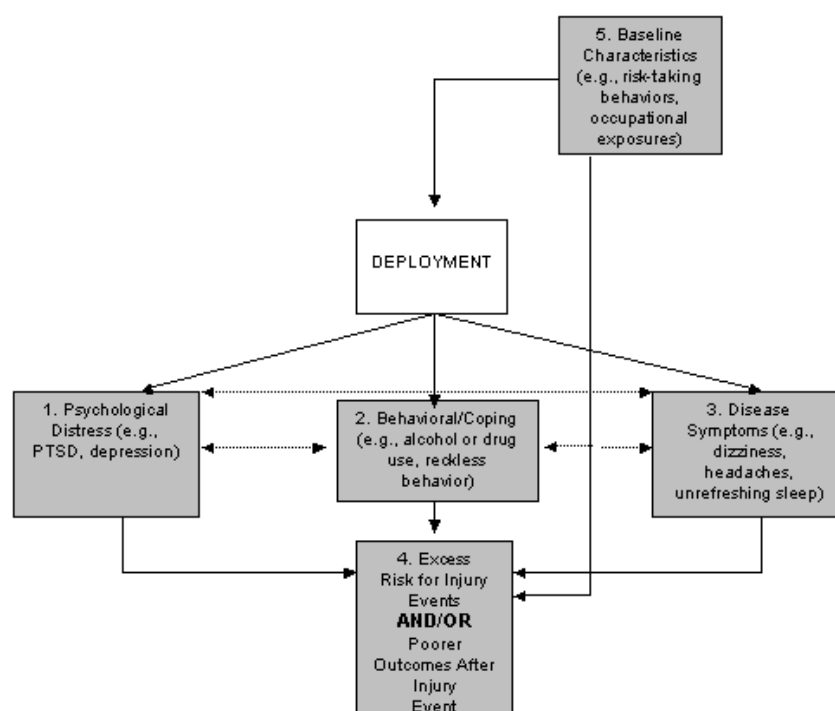
There is a likelihood that misclassification error may have occurred with respect to deployment status and that this error may have been systematic. For example, National Guard or Reservists may have been more or less likely to be miscoded than regular active duty Soldiers or, even more concerning, there may have been an association with health status and accuracy of deployment information. For example, if a Soldier who was sick could not deploy with his unit but nonetheless was coded as deployed (because most of his unit was deployed), this might erroneously suggest an association between illness and deployment. Efforts are underway to quantify the extent and potential impact of misclassification of deployment status. We are conducting a multi-site study to evaluate the extent of misclassification error and the impact it may have on published accounts of the effect of deployment on Soldier health. Collaborating with researchers at other institutions will allow us to use multiple sources of data to more accurately assess both the magnitude and direction of any bias in whether Soldiers have been defined as having been deployed or not deployed.

Injuries

Accidental injury and death has not been a major focus of inquiry with regard to the health of deployed GWE veterans, in spite of the fact that it is the only documented source of excess mortality in the post-war period (67). Historically, excess injury mortality was observed not only among U.S. but also among Australian veterans of the Vietnam conflict (29, 31-34, 46, 76, 116, 120, 121). We have proposed an analytic model suggesting five possible pathways by which deployment may increase post-war

risk of injury (see Figure 5). First, increases in injury mortality may be a consequence of depression, PTSD, and symptoms of other psychiatric conditions that emerge after deployment. Second, physical and psychological traumas experienced during deployment may lead to the post-war adoption of coping behaviors that might increase injury risk (e.g., alcohol or substance abuse). Third, the observed increase in injury risk may be the indirect consequence of the ill-defined symptoms reported by many ODS/DS veterans (e.g., concentration or memory deficits, difficulty sleeping). Fourth, deployed veterans may experience poorer survivability for a given injury event, resulting in greater mortality but not morbidity. Finally, the process that selects individuals for deployment may lead to a spurious association between deployment and injury, by preferentially selecting individuals who are risk takers and/or exposed to greater hazards (22, 23).

Figure 5. Potential explanations for the association between deployment and injury



Because the TAIHOD was originally created for the study of injury and because the research team has extensive experience in injury epidemiology, we are well prepared to assess this excess injury burden among deployed Soldiers. To date, however, there have not been enough resources available for this line of inquiry to utilize the TAIHOD in order to explore potential etiologic pathways linking deployment to excess post-war injury.

Deaths

Given the scale of the deployment and the rapid pace at which Soldiers were dispatched to the Gulf, deaths were relatively uncommon both during and since ODS/DS. During the deployment, there were 147 combat casualties and 225 deaths from injury and illness (127). Among ODS/DS veterans, death is still a relatively rare occurrence; in the 2 years following the war, 1765 Soldiers who deployed to the Gulf died (67). Although rare during ODS/DS, deaths are a devastating outcome and thus important to consider. In addition, the more recent Operation Iraqi Freedom (OIF), the largest military action since the Vietnam War, has resulted in many more casualties than were seen during ODS/DS. The TAIHOD is well poised for a study of non-battle injury occurring during and after deployments in support of OIF. The TAIHOD includes information on all servicemembers who died while on active duty, although the database has not yet been tapped for researching this type of outcome in relation to deployment. Though these data have not been fully explored, and although an assessment of casualties from ODS/DS was beyond the scope of the pilot study described in this report, the TAIHOD nonetheless has potential in this area of Force Health Protection research, especially with regard to the study of injury deaths.

RISK FACTORS, EXPOSURES, AND HEALTH BEHAVIORS

A key objective of the pilot TAIHOD study of ODS/DS veterans was to assess the potential role of stress and distress as a risk factor or effect modifier of the health of deployed GWE veterans. Initial plans for this called for pre- and post-war comparisons of measures of stress and distress contained in the Army's HRA surveys.

The Health Risk Appraisal (HRA)

One of the key data sources in our original grant proposal on health behaviors, stress, and distress as risk factors for GWI was the Army HRA. One of the biggest challenges and disappointments we have faced in our work has been the discovery that we had no pre-Gulf War Army HRAs available for analysis. We had originally anticipated having more than 22,000 completed surveys, with approximately 1,000 from Soldiers who deployed to ODS/DS. However, all of these surveys were ultimately deemed unusable due to one or more of the following problems. First, many HRA surveys in the database were not actually completed by an active duty servicemember. Even though the HRAs had SSNs, it was often difficult to determine whether the survey responses were truly those of an active duty Soldier or of a dependent family member. The HRA is offered to spouses and dependents who may complete the HRA under their sponsor's SSN. We took a conservative approach in data cleaning and management, and if we found that we could not positively determine whether a survey was completed by an active duty Soldier or by a family member, we excluded it from analysis. In addition, there were many duplicate and near duplicate surveys, often taken on or about the same day. We eliminated duplicates and in cases of near duplicates, we retained the one with the most completed responses. This cleaning step resulted in 393 surveys we believed to be valid for the pre-Gulf war period (107 surveys completed by Soldiers who later deployed to the Gulf and 286 surveys completed by non-deployers in the pre-

war period). We published a paper describing the demographic, health, and behavioral profile of non-deployed and deployed Soldiers in the pre-war period based, in part, on these surveys (23). The sample of Soldiers completing pre-war HRA surveys was small. Findings from analyses of the surveys were non-significant (insignificant?), but did seem to be consistent with results from analyses of hospitalization and demographic data, which were statistically significant. The hospitalization and demographic data showed decreased risk in the pre-war period for hospitalizations from all causes and for conditions most common among post-war CCEP registrants, but increased risk in the pre-war period for injuries.

Unfortunately, we subsequently developed evidence suggesting that *none* of these surveys were actually taken prior to the war. We believed we had obtained all of the HRA data, including files for surveys completed in the late 1980s, but have recently learned that the electronic repository of HRAs that we received was initiated in October of 1990 (that is, after the August 1990 invasion of Kuwait), and that all earlier HRAs (from 1987-1990) were kept in a separate database. The surveys we had, which we believed to be pre-war surveys, bear incorrect dates. This likely occurred because the HRA date information is read in from the DOS or Windows clock on the local computer when the survey was scanned. If the computer's clock was set incorrectly, an incorrect date of administration would have been recorded for that HRA, even though the software manual for the administration software cautioned HRA program administrators numerous times about this issue (2). It is not known how widespread this problem may have been. We have submitted a letter to the editors of *Military Medicine* in an attempt to document this problem and to ensure that other researchers are not misled by the erroneous findings we initially reported. In addition, we have continued our efforts to locate the surveys that were believed to have been completed in the late 1980s and early 1990s. We have interviewed numerous members of the original HRA project team, and although they all attest to having processed tens of thousands of HRAs between 1987 and 1990, no one seems to know where the electronic database that contains those surveys currently resides.

In addition to seeking information about the missing HRAs, we conducted interviews with members of the original HRA and Army Health Promotion Program in an attempt to piece together the history of the HRA program, the origins of the survey items, and the management of the resulting data. It has been extremely challenging because many of the individuals originally tasked with creating the database have since retired from the military or have little recollection of the program. Many of our findings have been detailed in a series of reports on the HRA program (26, 105). Though the TAIHOD currently does not contain HRAs that were completed in the period preceding ODS/DS, it does contain many more HRAs that appear to have been taken after the Gulf War (based on cross-checking the age the respondent reported on the survey and the birth date recorded in the personnel files). Others who plan to use HRA data for research purposes will need to take extra care in qualifying the survey date if it is important to establish a certain temporal order of the survey against the health outcome date they are studying. Among the 1,336,050 Soldiers on active duty between June 1991, and December 1998, we have more than 521,000 HRA surveys representing 408,374 individuals that have been positively linked to an active-duty

Soldier. This suggests that there are more numerous opportunities to investigate risk factors for health outcomes associated with more recent deployments than were present in the cohort of GWE veterans. Unfortunately, because the HRA program was officially discontinued in 1998 and because the HEAR is still not off the ground, the opportunity for studying health behaviors and health outcomes is diminishing with time. There is no representative repository of health habit data to study these types of risk factors pre- and post-more recent deployments. Some larger cohort studies currently underway may help address some of this limitation; for example, the Millennium Cohort Study (<http://www.millenniumcohort.org>). In addition, the so called “pre- and post-deployment surveys” also have the potential to help identify risk factors that affect deployed Soldiers health (<http://www.ha.osd.mil/policies/1999/clin9902.htm>).

Other Sources of Data on Stress

One of the fortunate aspects of working with a database as rich and varied as the TAIHOD is that even though we did not have sufficient pre-war HRAs, we were able to use other components of the database to create proxy measures of pre-war stressors. There is a great deal of interest in how demographic characteristics, occupational stressors, and familial factors may interact with deployment to influence susceptibility to stress and adverse health outcomes (100).

The TAIHOD contains extensive demographic and occupational information that is updated semiannually. This is an important strength of the TAIHOD because it allows us to identify subpopulations particularly at risk, to control for potential confounders, and to accurately assess population-based risk for various health outcomes. Because these data are updated at such frequent intervals, we are able to assess changes in health outcomes associated with changes in risk profiles (e.g., changes in marital status, job assignments, and hazardous duty exposures). We used pre-war demographic and personnel data to measure life events and changes likely to be stressful and that might interact with deployment to affect health. We hypothesized that Soldiers who experience a greater number of life events or putative stressors in the immediate pre-war era might be at greater risk for morbidity regardless of deployment status, and that these experiences may interact with deployment to increase risk.

To address these hypotheses, we identified a cohort of 511,449 enlisted Soldiers¹ on continuous active duty from December 1989 through June 1990 and measured several personal and occupational life events that occurred prior to the war (i.e., July 1, 1990). We followed these Soldiers through December of 1994 (i.e., 3 years after the end of the war) to assess risk for five specific health outcomes: any hospitalization, injury hospitalization, hospitalization for ill-defined signs and symptoms, hospitalization for psychiatric-related conditions, and hospitalization for musculoskeletal conditions. These outcomes were selected because they were of clinical importance (e.g., injuries are only known cause for excess post-war mortality), because an *a priori*

¹We selected only enlisted soldiers for this analysis in order to avoid problems related to near multicollinearity between rank and occupation (some occupations are open to only enlisted soldiers or to officers), and because enlisted soldiers are a larger group offering greater power for the study of life events and health outcomes.

determination was made that these outcomes were a logical outcome of stress exposure (e.g., psychiatric conditions have been linked to stress or distress), and/or because these conditions were prevalent among Soldiers who went to the Persian Gulf (e.g., the top three diagnoses for veterans enrolled in the CCEP program, other than “healthy,” included musculoskeletal disorders, psychiatric conditions, and ill-defined signs and symptoms). We used a three-digit level of aggregation in defining our outcome variables and examined only primary diagnoses.

Pre-war measures of potentially stressful events were assessed prior to June 1990. Pre-war status changes such as marital status or unit location were assessed between December 1989 and June 1990. This analysis is still underway, but to date, we have examined the impact of changes in unit location (i.e., change in ZIP code), number of dependents, marital status, grade extremes (i.e., either short or long in grade), spouse on active duty (particularly if he/she is also deployed), and discordance between primary MOS (the job an individual is trained for) and duty MOS (what they are actually assigned to do). We also control for the potential confounding effects of age, gender, rank, race, total time in service, and Career Management Field. We used standard time-to-event statistical techniques including Cox Proportional Hazard models and Kaplan-Meier Survival curves.

Table 2 shows results from preliminary analyses of these data. This table shows the unadjusted influence of deployment on risk for each health outcome in the 3-year follow-up period. In the unadjusted model, deployers were significantly *less* likely to be hospitalized for any cause or for signs, symptoms, and ill-defined conditions. On the other hand, they were significantly *more* likely to experience a psychiatric or injuryrelated hospitalization. The data demonstrate one of the advantages of having a variety of demographic and other information available to control for potential confounding. The bottom row of the table showing results from multivariate models indicates that once we control for age, gender, rank, race, education, occupation, and pre-war life stressors, such as change in marital status, moving, and having a spouse deployed, the effect of deployment, though still significant, is greatly reduced for injury hospitalization. Likewise, the apparent protective effect of deployment on risk for Ill-Defined Signs and Symptoms is mitigated by the inclusion of demographic characteristics and pre-war stressor covariates in the model. The post-war increased risk for psychiatric hospitalizations, however, does not seem to have been attenuated by the inclusion of covariates in the full model. Deployed Soldiers are at greater risk for a psychiatric hospitalization after redeployment even after we control for demographic characteristics and pre-war life events.

Table 2. Univariate and Multivariate Cox Proportional Hazard Models: The Influence of Deployment and Pre-war Stressful Life Events on Selected Health Outcomes of Gulf War Era Veterans, 1990-1993.

Variable	Any Hospitalization	Injury Hospitalization	Psychiatric Hospitalization	Musculo-skeletal Hospitalization	Ill-Defined Signs & Symptom Hospitalization
Deployment Only	0.98‡	1.20‡	1.14‡	0.98	0.85‡
Adjusted Deployment*	1.06‡	1.06‡	1.13‡	1.02	0.98

‡p<.05

*Influence of deployment after adjusting for change in unit location (ZIP code), change in number of dependents, change in marital status, low or high average time in service for rank, spouse's active duty and his/her deployment status, discordance between trained and actual job assignment (primary versus duty MOS), education, age, gender, rank, race, and MOS.

Table 3 shows the hazard ratios for specific types of hypothesized life stressors and their influence on each health outcome. Though not shown, this model also controlled for age, gender, race, rank, MOS (job), education, and deployment. While most of these stress-related variables were significant in univariate models, the overall impression is that once we account for demographics and deployment, the effect of these pre-war stressors is rather small, even where they are statistically significant. There are, however, a few possible and notable exceptions. First, a change in unit location (i.e., moving) in the time period *before* deployment (i.e., in our analyses we assessed between 3 and 18 months before the war began) is related to an increased risk for post-war health problems, even after controlling for deployment. Second, having a spouse on active duty, especially if he or she was also deployed to the Gulf, increased the risk for a post-war hospitalization by about 10% as compared to being single. The etiology of such an association is not clear. If it were related to stress or distress, then we would expect the association to hold for psychiatric-related hospitalizations as well. In contrast, single Soldiers (the referent group) appear at greatest risk for a psychiatric hospitalization in the post-war period. Third, being in a given rank for an excessively long time (longer than the other 80% of the cohort) increases risk of hospitalization, in general, and specifically for hospitalizations related to signs, symptoms, ill-defined conditions, and musculoskeletal disorders. The referent group (i.e., those in their grade for a very short time) is at lowest risk. On the other hand, risk of injury in the post-war period is lower among those in their grade the very longest, even after controlling for age and MOS. This might suggest that these Soldiers are in their jobs for a long time and understand the risks well and may be, therefore, at lower risk for an occupationally related injury. It could also have to do with their behaviors and propensity for risk taking, which could influence both their injury risk and their promotability.

Table 3. Multivariate Proportional Hazard Models: Pre-war Stressful Life Events, Deployment and Post-war Hospitalizations Among Enlisted Army Soldiers, 1990-1993*

Variable	Any Hospitalization	Injury Hospitalization	Psychiatric Hospitalization	Musculo-skeletal Hospitalization	Ill-Defined Signs & Symptom Hospitalization
Change in unit ZIP					
No Change	1.00	1.00	1.00	1.00	1.00
Change	1.04‡	1.03‡	1.09‡	1.02	1.03
Primary/Duty MOS					
Agreement	1.00	1.00	1.00	1.00	1.00
Discordance	1.02‡	1.00	1.09‡	1.00	0.96
Number of Dependents					
No Change	1.00	1.00	1.00	1.00	1.00
Change	1.02	0.97	0.94	1.09‡	1.02
Marital Status					
Single	1.00	1.00	1.00	1.00	1.00
Spouse not on active duty	1.05‡	0.87‡	0.94‡	1.05‡	1.05
Spouse on active duty, not deployed	1.07‡	0.92	0.90	1.01	1.01
Spouse on active duty, deployed	1.10‡	1.07	0.81	0.96	0.93
Time in Grade					
Shortest	1.00	1.00	1.00	1.00	1.00
Short	1.00	0.99	1.02	1.01	1.02
Average	1.00	0.97	0.92‡	1.02	1.07
Long	1.01	0.93‡	0.95	1.07‡	1.09
Very Long	1.06‡	0.91‡	0.96	1.11‡	1.17‡

*Model also controls for age, gender, race, rank, MOS (job), education, and deployment. (Hazard ratios not shown.)

‡ p<.05

Certain factors such as educational attainment, intelligence, and social support may help Soldiers cope with stressors. The Armed Services Vocational Aptitude Battery (ASVAB) is a measure of aptitude that all enlisted Soldiers must take upon entry to the military (82). It measures various dimensions of intelligence, such as word knowledge, paragraph comprehension, arithmetic reasoning, and mathematic knowledge. We are currently exploring the utility of the ASVAB as an indicator of resiliency, but have not yet completed these analyses.

In addition to exploring changes in risks and exposure to stressors in the pre-war period, the breadth and scope of demographic data available in the TAIHOD also allow us to compare baseline differences in demographic characteristics between deployed and non-deployed Soldiers. This is a necessary step before it is possible to make a determination about differences between deployed and non-deployed Soldiers in the post-war period. These data allowed us to publish findings related to pre-war (baseline) demographic and health status that had not previously been reported in the literature (23). Our work revealed that Soldiers who were deployed for ODS/DS were more likely to have received special pay for hazardous duty exposures occurring prior to deployment than were their non-deployed peers, even after controlling for occupation. In addition, we found an excess injury hospitalization risk for deployed Soldiers in the

pre-war period even after controlling for demographic factors and occupation. This suggests deployed Soldiers may be greater risk takers and/or more likely to experience exposures that would increase risk for injuries, such as parachuting duty (30). These exposures could have persisted throughout and after the war and may explain, in part, the excess injury mortality that has been documented among post-war ODS/DS veterans (67).

The same approach we have taken to evaluating life changes and influences on deployed and non-deployed Soldiers can be used to identify potentially high-risk groups of Soldiers in future deployments. It also suggests that more research should be done to assess the generalizability of these findings to other types of deployments and perhaps to other health outcomes.

DMDC Surveys of Active Duty Soldiers

The TAIHOD contains other survey data that may be used to better understand the diverse factors that could affect the health of deployed Soldiers. As described earlier in this report, the DMDC administered surveys to a stratified random sample of active duty military in 1985, 1992, and 1999. While the forms varied slightly across years, there were many items that were identical for each survey that will allow us to make many important comparisons across time. We believe that this survey contains information that will prove useful in the study of stress and deployment-related health. Though this was not specifically included in our pilot grant, we have begun exploring these data in order to assess how well they might be able to address some of our research interests.

We compared responses to 14 survey items that appeared on both the 1985 and 1992 surveys and that related to satisfaction with military life (e.g., personal freedom, job security) among Soldiers who took this survey in both years. We also created a summary variable that summed scores for all 14 variables and compared summed scores at Time 1 and Time 2. For ease of comparison we dichotomized the variables to reflect a decrease in satisfaction from 1985 to 1992 versus no decrease (see Table 4).

When we examined changes in satisfaction based on the overall sum of scores for the 14 items, more than half of all Soldiers, both deployed and non-deployed, showed a decrease in satisfaction over time. However, deployed Soldiers reported steeper decreases in satisfaction: 58% of deployed respondents compared to 51% of non-deployed respondents showed decreases in satisfaction from 1985 to 1992.

When we examined decreases in satisfaction for each of the individual 14 survey items using chi-square tests, deployers were generally more likely to show decreases than were non-deployers, but surprisingly, this reached statistical significance only for the variable that asked about satisfaction with the opportunity to serve their country. Dissatisfaction with job training/in-service education and working/environmental conditions was also greater for deployers, but not significant at the standard .05 level.

Because parametric tests are generally more powerful, we also ran ANOVA models to compare the mean differences in total (summed) scores from 1985 to 1992 across deployed and non-deployed Soldiers and for each of the individual 14 items. As before, both groups showed decreases in satisfaction, and the decrease was significantly greater for deployers than non-deployers. With the ANOVA model, all the items shown here reach statistical significance.

Because both groups reported declines in satisfaction, this could reflect an aging or cohort effect, or it might reflect actual declines in overall satisfaction with military life. Because satisfaction declined more among deployers than it did among non-deployers, this could be related to their experiences in the Gulf or, because these analyses are not controlling for demographics, could reflect greater declines in satisfaction among certain demographic groups who were also more likely to deploy. It may be more important, however, to understand how these changes in satisfaction, coupled with deployment, may affect the health and well-being of Soldiers. Future analyses could focus on these variables and their relationship with health outcomes.

Table 4. Changes in Satisfaction Between Soldiers Who Did and Did Not Deploy to the Persian Gulf, as Documented in Selected Items from the 1985 and 1992 DMDC Occupational Surveys

Variable (item)	Percent Decrease from 1985 to 1992		Chi-Square p value
	Deployed	Non-Deployed	
Composite of All 14 Variables on Satisfaction	58%	51%	p<.05
Opportunity to Serve Country	36%	27%	p<.005
Job Training/In-Service Educational Opportunities	36%	31%	p<.10
Work or Environmental Conditions	34%	29%	p<.15

* Note: All Survey Items Shown were Statistically Significant in ANOVA models at p<.05.

TAIHOD AND VA PILOT LINKAGE EFFORT

Studies focusing only on Soldiers who remain on active duty may be susceptible to healthy worker bias. This bias would result in an underestimation of the true magnitude of morbidity and mortality, as only those who are most healthy remain on active duty. Because health records for Soldiers on active duty are maintained separately from those who have been discharged and are seeking care through the VA or civilian healthcare plans, most studies of deployed GWE veterans completed to date capture only the experiences of selected samples of veterans who are either still on active duty (53) (23) or who have left the military (89), or who are defined by a selected geographic area (117). Many of the government panels charged with evaluating the quality of research on GWI commented on how the research portfolio was hampered by restrictions on data sharing between the DoD and the VA (63, 96). In order to get a more cogent and complete assessment of the impact of deployment on Soldier health, longitudinal studies and collaborative ventures between these two agencies are needed.

In 2001 and 2002, the TAIHOD team embarked on a collaborative venture with the Massachusetts Veterans Administration Epidemiology Research and Information

Center to study the natural history of musculoskeletal injury, related disabilities, and how they impact utilization of care in the Army and VA healthcare systems. (126) Although not specifically related to deployment, the overriding goal of this venture was to assess the feasibility of linking Army and VA data. While the project met with some success, a number of challenges were identified that will need to be addressed before future collaborative work can be successfully completed: refining a protocol for linking data that preserves the integrity of the data while protecting the privacy of individual data; amassing enough computer resource space to house the large database and run analytic programs on the data; and better communication about appropriate avenues for data sharing and project management.

CHAPTER 3: RESEARCH RESOURCES: STRENGTHS AND WEAKNESSES OF THE TAIHOD AND OTHER LINKED DATABASES FOR FORCE HEALTH PROTECTION RESEARCH.

INTRODUCTION

Large databases, such as the TAIHOD, that link administrative data on demographics, health outcomes, exposures and risk factors, have been in use since the 1950s. The use of database exploration in epidemiology is a rapidly growing field, and there have been many recent articles in the medical literature about the benefits and the methodological hazards commensurate in their use (17, 78, 99, 125). These types of databases have been used to study conditions as varied as cardiovascular disease, cancer, congenital birth defects, hereditary conditions, neurological disorders, diabetes, infectious disease, and trauma (11, 15, 16, 19-21, 36, 37, 44, 58, 60-62, 75, 92, 102, 107, 123).

The civilian database research project that bears the closest similarity to the TAIHOD project is the Rochester Epidemiology Project. Founded in 1966 and housed at the Mayo Clinic in Rochester, MN, this project links medical records through a system of medical record management that was established in 1907 (88). Since then and up to this day, all patients who are treated at any Mayo Clinic facility or one of the affiliated hospitals are assigned a unique identifier. It is an important resource for population-based studies and has, in fact, been used to study conditions as wide ranging as cardiovascular disease; various cancers; musculoskeletal conditions (e.g., hip fracture, osteoporosis, Paget's disease); neurological conditions (especially epilepsy, Alzheimer's, and Parkinson's diseases); ophthalmologic conditions (e.g., cataracts, retinal detachment); endocrine or autoimmune disorders (e.g., diabetes mellitus, hyperparathyroidism, and lupus); and a host of other infectious and acute conditions. Studies have documented not only the prevalence of these conditions and their etiologic origins, but also have examined the relative efficacies of various treatments, or the consequences of treatment modalities and referral patterns on outcomes. This rich epidemiologic resource has resulted in the publication of more than 900 peer-reviewed journal articles and has contributed enormously to our understanding of acute and chronic disease processes. The TAIHOD has a structure very similar to the Rochester Epidemiology Project, with the potential for studying a wide range of conditions of importance to Army Soldiers.

CHALLENGES

The data contained in the TAIHOD are administrative in origin and were not collected specifically for research purposes. Thus, there are important limitations to their use and interpretation that must be well understood before any given study is initiated. For example, measures of exposures and health outcomes are not typically assessed for reliability or validity in any rigorous way before they are received at USARIEM. Data

quality and accuracy are typically of greater importance in a research setting than for administrative purposes. Data misclassification may be randomly distributed, but if it is non-random or systematic, it can significantly bias research findings. Researchers who use administrative data sources in epidemiologic work must be cognizant of the many issues that surround data collection and interpretation and proceed cautiously in analyses. In the next section we describe some of the different ways in which we have used these secondary data for research purposes, highlighting the pitfalls we discovered, and options available for addressing data limitations.

One challenge in maintaining internal funding for the TAIHOD project has been the concern over whether or not work with the TAIHOD may be most accurately labeled as research or surveillance. Within the DoD there has been an attempt to distinguish between research and surveillance missions, but this distinction is not always clear and seems to have resulted, in some cases, in disputes over appropriate job roles, competition for funding, and discrepancies in the level of scrutiny related to data protection. Generally, activities labeled as “surveillance” are not subject to human use oversight, while “research” activities, even when they use the same or similar data, can proceed only after rigorous scientific and human use review and approval (6). At a superficial level, the fact that the TAIHOD draws upon data collected for administrative purposes and not specifically for research may appear to blur the boundaries or add to confusion between what constitutes research and what constitutes surveillance.

Research and surveillance are two distinct, though often confused, enterprises with different goals, data requirements, and analytic methods. Surveillance databases are typically used to monitor specific known causes of injury or illness, track rates and trends, and plan for the efficient allocation of health-delivery resources (101). This information is useful for identifying appropriate research questions and activities in order to delve further into the problem. In contrast, although research may often rely on data obtained from multiple surveillance projects and administrative sources, the primary goal of research is to identify new risk factors or causes of injury or illness. Surveillance data must be collected in routine and consistent ways in order to facilitate the evaluation of rates over time; such data systems are typically designed to be flexible and simple, while producing data that are timely and representative. Research studies must be designed to withstand rigorous statistical and scientific scrutiny, and where research projects draw upon surveillance data, careful attention to the idiosyncrasies of data collection efforts, coding, and recoding is essential to research efforts. For example, the importance of accurately matching information on unique individuals in a database to be used for research purposes cannot be overstated, as incorrect matches may compromise the integrity of the tool, invalidate the results of the research, or mask true associations. A similar example can be illustrated with the Army hospitalization databases, which contain records of transfer events (i.e., continuation of care for the same injury event) and Carded for Record only files on DOAs, ER deaths, and disabled Soldiers. Misclassifying transfer cases as separate events has been shown to impact estimates of effect in studies of injury outcomes (52, 91, 106, 122). Similarly, although CRO records contain information that is useful in the study of deaths and disabilities, it would be inappropriate to count them as bona fide episodes of hospitalization (5, 7, 106). The ability to conduct epidemiologic research using surveillance data is thus, in

part, a fortunate byproduct of meticulous record keeping by administrative and surveillance projects, but research using surveillance data must always be carried out with an awareness of these idiosyncrasies. The analytic methods used in surveillance and research also may differ. Surveillance efforts typically use statistical methods that are straightforward and descriptive (101). In contrast, research typically employs more complex methods with rigorous controls over potential confounding factors. Research activities also begin with an *a priori* hypothesis to be tested and often employ use of a control group in order to separate out true effects from random error or confounding (101). Surveillance and research are therefore complementary activities; each represents a vital component of any comprehensive injury or illness control program.

Another challenge to using linked secondary data such as those contained in the TAIHOD, pertains to the ever-increasing concerns about confidentiality and privacy of personal information. It should be noted that public health research in the Army typically undergoes more rigorous scrutiny and oversight with regard to protection of human subjects and confidentiality than perhaps surveillance efforts. Surveillance efforts are policed by a completely different process (9) (6). The ever-growing concerns about confidentiality and privacy of medical records and the impact this may have on epidemiologic work using large databases has recently received widespread attention (65, 77, 85, 90, 118, 128). A recent Government Accountability Office (GAO) report about privacy issues surrounding data linkage acknowledged the concerns of privacy advocates, but noted that such research projects hold considerable benefits to public health. The GAO report describes a variety of techniques to address privacy issues, while allowing collaborative research projects involving data linkage to proceed (118).

BENEFITS

While maintaining a large linked research database, such as the TAIHOD, is not without its challenges, there are numerous opportunities that should be noted. The TAIHOD is a ready tool that can be used to address a wide range of research interests rapidly and cost-effectively. While databases can be put together from scratch in order to answer questions of this nature, the TAIHOD is already well established. Furthermore, a team of individuals and collaborators familiar with the relevant component datasets are already actively engaged in similar research and could be rapidly mobilized to accomplish this critical Force Health Protection study.

Our approach to data management includes a combination of scrupulous data linkage and error checking, and deliberate efforts to systematically validate the quality of the data within the TAIHOD. New data that are integrated into the TAIHOD are cleaned and evaluated to eliminate anomalous entities (e.g., duplicate records). Because the TAIHOD contains such a broad range of data, we have been able to validate data components cost-effectively by comparing them to other sources of data within the TAIHOD. For example, we have validated the responses on the Army's HRA regarding alcohol consumption by comparing the responses on those items to hospitalization records for alcohol-related conditions such as cirrhosis and to discharges from the Army for alcoholism (27). Finally, we have experimented with methodologies used in the field of "Knowledge Discovery in Databases", which combines elements of data warehousing

and data mining. A recent example of this is the validation of gender coding in the TAIHOD using first and middle names, as well as gender specific diagnoses (3).

These include the ability to rapidly assess or evaluate the relative quality of data due to the presence of duplicate or redundant measures of some factors, and the ability to incorporate a wide range of information in a study. Because data are already linked and, in many cases, error-checked and cleaned, rapid assessment with little startup time is usually possible. This can greatly reduce research costs and shorten time to achieving results.

The TAIHOD is quite comprehensive, covering a diverse range of information on health outcomes and risk factors, which allows not only for the investigation of many different health concerns and behaviors, but also the ability to control for many potential confounders. Because the TAIHOD includes comprehensive information on *all* active duty Army Soldiers and covers such a long time span, it offers the opportunity to study health status and risk factors for adverse health outcomes before and after key events such as deployments. The breadth and depth of data available in the TAIHOD make it appealing as a potential source of information on the health of deployed Soldiers, as well as Soldiers performing peace-time missions.

The core TAIHOD research team includes a diverse group of skilled and experienced epidemiologists, programmers, and research scientists who have developed considerable experience with the idiosyncrasies, strengths, and limitations of the various components of the TAIHOD. In most cases, the staff has been working with TAIHOD data for at least 2 years and thus has already climbed much of the rather steep learning curve confronting any researcher who endeavors to work with any one of the many complex data files contained in the TAIHOD. A large network of outside collaborators also adds to the breadth and capabilities of the core TAIHOD team. The presence of an experienced, trained core staff of individuals who are familiar with the datasets facilitates the ability to quickly use data that might take an unfamiliar research team many months to fully understand. This may be particularly important when there is a potentially serious health problem that must be quickly assessed and/or where a policy decision must be made rapidly. When a researcher is ready to embark on a particular analysis, they will necessarily weigh the availability of data in any decision regarding choice of variables for analysis and study designs supported by the available data. If a wider range of variables is available, the researcher is able to make these decisions about data availability or acquisition time more on scientific merit than on administrative considerations. This has been one of the central premises used to justify creation and maintenance of the TAIHOD as a tool for research, as opposed to the one-by-one acquisition and assembly of datafiles for particular analyses. On the one hand, devotion of time and resources by the research team to database enhancements diverts efforts from the primary research activities, limiting the amount of analysis and publications on health-related research that can be completed. At the same time, these efforts hold the promise of greatly improving the efficiency and quality of future research.

Epidemiologic research also stands to improve the process of surveillance by highlighting limitations in data collection and providing feedback to those who maintain and collect surveillance data. For example, surveillance systems often rely upon records of inpatient hospitalizations in describing the scope of a particular health problem, such as injury. The inpatient hospital record contains useful demographic information, as well as information about the nature of the person's illness or injury. These hospital records, however, often lack detailed or specific information about the external factors that caused the patient's injury, which would be useful in research endeavors. The military hospital system uses the STANAG system for coding external cause of injury in general terms. Though the proportion of military injury hospital records with external cause-of-injury codes is higher than the proportion of civilian hospital records with this information, there are still limitations to conducting injury epidemiological research in the military and in making comparisons to routinely collected data on the U.S. population at large. Military injury researchers have long advocated for the adoption of a Minimum Basic Data Set for intentional and unintentional injuries and the universal application of cause of injury coding to medical records in military and civilian settings in order to improve the quality and quantity of detailed data available for injury research (79-81, 95). While the existing records with STANAG codes may assist surveillance experts in describing the nature and some of the causes of the injury problem in a specific population and in planning the allocation of resources (e.g., the design and delivery of educational interventions), researchers who hope to discover the underlying risk factors that contribute to these injuries would be assisted by greater availability of more detailed information about the external cause of the injury, particularly the more common injuries that are often treated in an outpatient setting. Research may also result in improvements in data quality by providing input to the development process for new data systems (e.g., the Army's CHCS II), including the ADS, as well as suggestions for capitalizing on the structure of existing systems (e.g., CHCS). Changes to coding systems used in recording data may also be beneficial. For example, the STANAG system or the International Classification of Diseases (ICD) may require modifications in order to improve accurate capture of data injury and illness, especially with regard to unique military requirements. In this way, research activities may lead to the development of new methodologies that make the surveillance process more productive, efficient, and accurate.

The TAIHOD data are continually being updated and thus new research opportunities continue to arise. This is important for identifying critical issues related to Force Health Protection. It also has the added benefit of enticing internationally renowned health researchers to develop collaborative relationships with active duty military researchers. All stand to benefit from such associations. Last year we completed a top to bottom review by a newly appointed panel of experts, the TAIHOD Steering Committee. This committee of outside experts includes senior scientists and specialists with expertise in informatics, epidemiological methods, ethics, and psychology. A member of a local Veteran's Service Organization was also included in order to represent the interests of the individuals whose data are contained in the database. The recommendations of this panel are being pursued and are expected to improve the quality and utility of the TAIHOD database project.

CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The TAIHOD represents a unique tool and strategy for epidemiologic research, in general. By investing resources in management of this data, a tool is readily available for emerging areas of interest, such as Force Health Protection research. While many of the same data sources exist elsewhere and are “cobbled together” as needed for specific analyses, there are some limitations to these efforts that are overcome by the ready availability of a system such as the TAIHOD.

Maintaining and actively managing the TAIHOD database may appear to be more expensive or less efficient than constructing limited, single-use datasets for specific sets of analyses. However, the opposite may in fact be true. Having it readily available allows for significant time savings in executing analyses and also allows investigators considerable freedom to select from a wide range of data sources. This minimizes the often lengthy process of data acquisition and cleaning. In balance, these databases are complicated, and there is a steep “learning curve” in terms of understanding the processes used to collect the data and the way the individual variables are constructed. Some databases have dozens of variables that appear to measure the same or similar attributes. The TAIHOD team has devoted considerable time to researching the origins of items and the exact definitions, strengths, and limitations of these variables. In the 10 years since its inception, the TAIHOD staff has gained important experience working together in managing and analyzing these data and is very familiar with the individual component database structures and idiosyncrasies of the variables contained within. Finally, the richness and breadth of the data contained in the TAIHOD often allows for rapid data quality checks where there is overlap or redundancy of information between different datafiles contained in the TAIHOD.

RECOMMENDATIONS

- Additional study of post-deployment injury using TAIHOD.
- Add data on other deployments to compare risks to ODS/DS deployment and to judge the effect of multiple deployments on Soldier health.
- Validate Gulf War deployment activation file(s).
- Use HRAs cautiously—be sure individual surveys are clearly those of active duty servicemembers and not his/her family members; be sure he/she is on active duty; attempt to remove duplicate scans; insure appropriate data are being linked by confirming HRA completion date and dates from other files, such as personnel, are reasonably close.
- Continue efforts to validate HRA items.
- Document reliability and validity of HEARS items.
- Continue to identify important research questions that can be addressed by this tool.

- Enhance collaborative research activities between TAIHOD and other sites using large linked databases to reduce any overlap and to take advantage of corporate knowledge regarding strengths and limitations of the data components.
- Re-evaluate the roles of surveillance and research activities in the military to clarify appropriate tasks.
- Review procedures in place in all facilities using linked databases to be sure all researchers are adhering to appropriate standards for the adequate protection of human subjects.
- Disseminate reports such as this document and others that highlight the strengths, limitations, and pitfalls that researchers using any of these databases must be aware of in order to conduct high-quality research.
- Continue development and exploitation of free text obtained from various sources including military hospitals, the Army Safety Center, the USAPDA, and the ACIPS.

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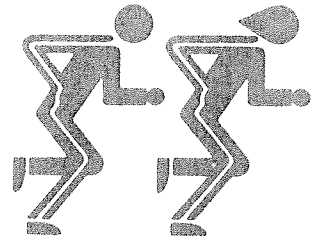
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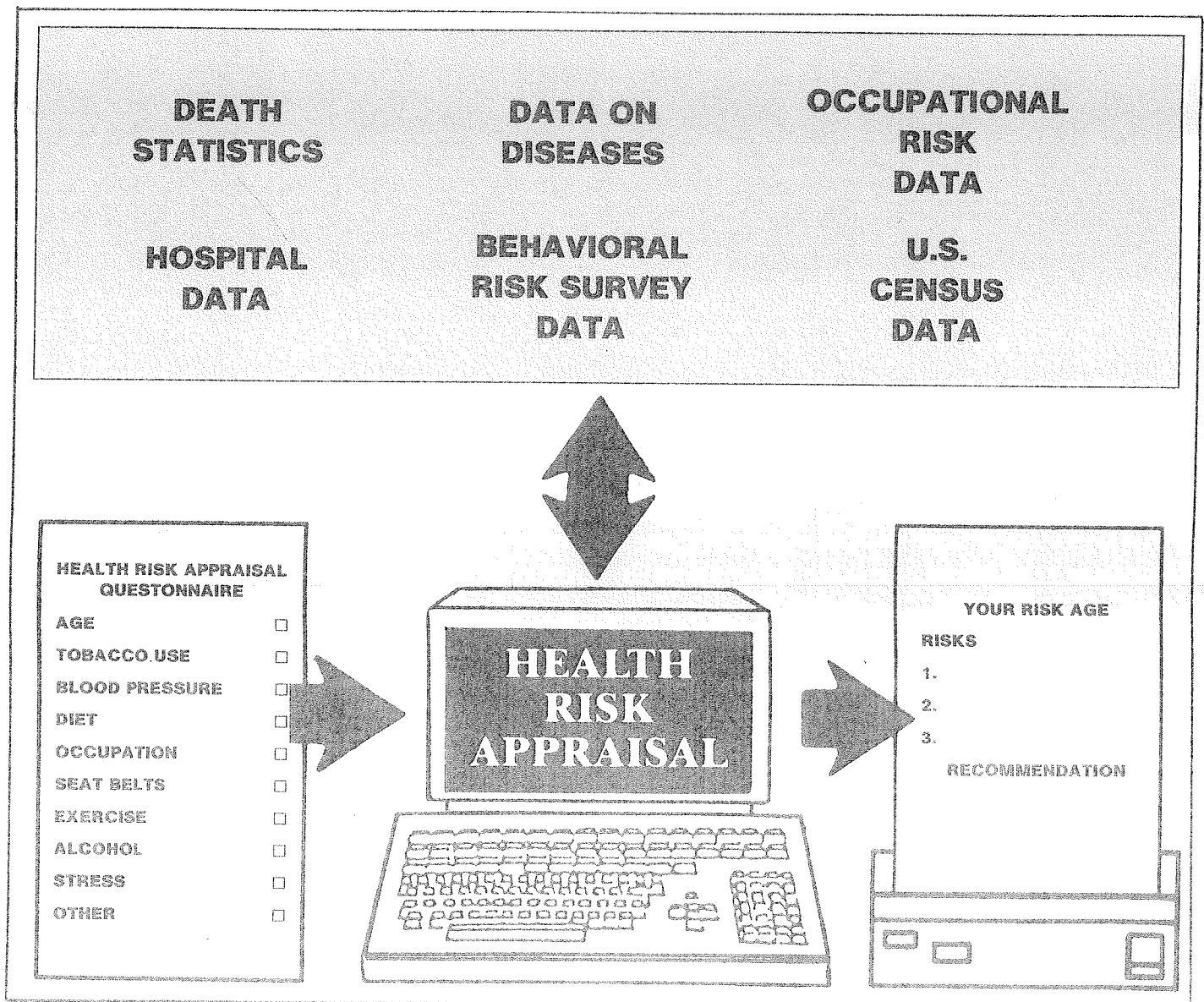
APPENDIX A: HRA SURVEY (1992)

THE HEALTH PROMOTION PROGRAM

Fit to Win

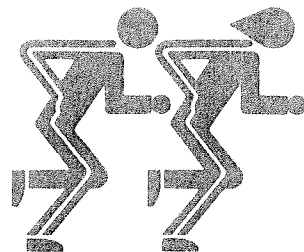


HEALTH RISK APPRAISAL



For use of this form, see AR40-501 and AR600-63; the proponent agency is TSG

FIT TOWN



TM

The HEALTH RISK APPRAISAL is an activity of
THE HEALTH PROMOTION PROGRAM

How does the Health Risk Appraisal work?

The health risk appraisal is a personalized estimation of your risks of death and major illness in the next ten years. First, the program uses your age and health-related personal habits, as well as national statistics on risk factors and diseases, to calculate your current risks.

Your risk may be expressed in terms of RISK AGE or HEALTH SCORE. Ideally, you want a risk age lower than your real age or a health score of 100 points.

The second part of your health risk appraisal calculates your risks again, as if your risk factors were reduced as much as possible. The result is your "target" risk age or health score. It shows your potential benefit, in health terms, of improving your lifestyle-if you quit smoking, wear safety belts, take moderate exercise, etc.

Therefore, your health risk appraisal report includes your real age, your current risk age and your target risk age. Your current risk age tells you how healthy your lifestyle is right now, and your target risk age lets you know how much longer and healthier you can live with a few positive changes in your lifestyle.

PLEASE ANSWER QUESTIONS AS HONESTLY AND AS CORRECTLY AS YOU CAN.
This will allow you to receive the most accurate assessment of your health.

The results of the Health Risk Appraisal are for you. We ask that you give us your name so we can return your results and any recommendations for follow-up care to you. We also ask for your social security number so we can statistically track trends in health awareness over long periods of time. Statistical information may be collected from an wide database which will contain your information, but your name and social security number will be covered and cannot be read. The rules of the Privacy Act apply to any information that you give in the Health Risk Appraisal.

IMPORTANT NOTE! The health risk appraisal is no substitute for a physical examination or check-up. It will not give you a diagnosis nor will it tell you how long you will actually live. However, the health risk appraisal will help you understand and recognize your risk factors.

INSTRUCTIONS

Please use a No. 2 Pencil only to complete this survey. Make dark, black marks that fill the response boxes completely.

EXAMPLE: Correct Incorrect



Health Risk Appraisal (HRA)
for use of this form, see
AR40-501 and AR600-63;
the proponent is TSG

1. What is your branch of service?

1. ☐ U.S. Army ☐ U.S. Marines
☐ U.S. Navy ☐ U.S. Coast Guard
☐ U.S. Air Force ☐ Other

2. What is your military status?

2. ☐ Active ☐ Reserve
☐ Active Reserve ☐ Guard
☐ Active Guard ☐ Other

3. What is your current rank?

3.

ENLISTED		OFFICER		WARR. OFFIC.
<input type="checkbox"/> E-1	<input type="checkbox"/> E-6	<input type="checkbox"/> O-1	<input type="checkbox"/> O-6	<input type="checkbox"/> WO-1
<input type="checkbox"/> E-2	<input type="checkbox"/> E-7	<input type="checkbox"/> O-2	<input type="checkbox"/> O-7	<input type="checkbox"/> WO-2
<input type="checkbox"/> E-3	<input type="checkbox"/> E-8	<input type="checkbox"/> O-3	<input type="checkbox"/> O-8	<input type="checkbox"/> WO-3
<input type="checkbox"/> E-4	<input type="checkbox"/> E-9	<input type="checkbox"/> O-4	<input type="checkbox"/> O-9	<input type="checkbox"/> WO-4
<input type="checkbox"/> E-5		<input type="checkbox"/> O-5	<input type="checkbox"/> O-10	

4. What is your Unit Identification Code?
(Enter Specific Unit Identifier)

Print your Unit Identification Code in these blank boxes.

Then fill in the corresponding response box below each number/letter.

4.

PRIVACY ACT STATEMENT

AUTHORITY: 29 CFR Chapter XVII, Occupational Safety and Health Standards; 5 U.S.C., section 150; Executive Orders 11612 and 11807 authorize the collection of this information.

PURPOSE: The primary use of this information is by the unit medical care providers to assure competent medical care. Additional disclosures of this information may be: To the Office of the Surgeons General in aggregated form to develop Command fitness profiles; to military medical researchers for the purpose of correlating health precursors to health problems or to commercial medical researchers for the same purpose. Where data from this system of records are provided to agencies external to the military, Social Security Number and Name will be deleted.

ROUTINE USES: Information may be disclosed to departments and agencies of the Executive Branch in performance of their official duties relating to health risk appraisal and cardiovascular screening.

DISCLOSURE: We ask that you give your name so we can return your results and any recommendations for follow-up care to you. We also ask for your social security number so we can statistically track trends in health awareness over long periods of time.

UNIT CODE					
A	A	A	A	A	A
B	B	B	B	B	B
C	C	C	C	C	C
D	D	D	D	D	D
E	E	E	E	E	E
F	F	F	F	F	F
G	G	G	G	G	G
H	H	H	H	H	H
I	I	I	I	I	I
J	J	J	J	J	J
K	K	K	K	K	K
L	L	L	L	L	L
M	M	M	M	M	M
N	N	N	N	N	N
O	O	O	O	O	O
P	P	P	P	P	P
Q	Q	Q	Q	Q	Q
R	R	R	R	R	R
S	S	S	S	S	S
T	T	T	T	T	T
U	U	U	U	U	U
V	V	V	V	V	V
W	W	W	W	W	W
X	X	X	X	X	X
Y	Y	Y	Y	Y	Y
Z	Z	Z	Z	Z	Z
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

5. ☐ Spouse (husband or wife of active duty or Military Retiree)
- ☐ Retiree
- ☐ Son or daughter of Active Duty or Military Retiree
- ☐ DOD Employee
- ☐ Non-DOD Employee
- ☐ Other

Mark ALL categories applicable to you.

6. ☐ WG ☐ GS ☐ SES ☐ GM
- ☐ 1 ☐ 6 ☐ 11 ☐ 16
- ☐ 2 ☐ 7 ☐ 12 ☐ 17
- ☐ 3 ☐ 8 ☐ 13 ☐ 18
- ☐ 4 ☐ 9 ☐ 14
- ☐ 5 ☐ 10 ☐ 15

6. If you are a Civilian Government Employee, enter your category and current pay grade.

7. LAST NAME

FI

A	A	A	A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B	B	B	B
C	C	C	C	C	C	C	C	C	C	C
D	D	D	D	D	D	D	D	D	D	D
E	E	E	E	E	E	E	E	E	E	E
F	F	F	F	F	F	F	F	F	F	F
G	G	G	G	G	G	G	G	G	G	G
H	H	H	H	H	H	H	H	H	H	H
I	I	I	I	I	I	I	I	I	I	I
J	J	J	J	J	J	J	J	J	J	J
K	K	K	K	K	K	K	K	K	K	K
L	L	L	L	L	L	L	L	L	L	L
M	M	M	M	M	M	M	M	M	M	M
N	N	N	N	N	N	N	N	N	N	N
O	O	O	O	O	O	O	O	O	O	O
P	P	P	P	P	P	P	P	P	P	P
Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
R	R	R	R	R	R	R	R	R	R	R
S	S	S	S	S	S	S	S	S	S	S
T	T	T	T	T	T	T	T	T	T	T
U	U	U	U	U	U	U	U	U	U	U
V	V	V	V	V	V	V	V	V	V	V
W	W	W	W	W	W	W	W	W	W	W
X	X	X	X	X	X	X	X	X	X	X
Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z

7. Your Name.

Print the first ten letters of your last name and your first initial in these blank boxes.

Then fill in the corresponding response box below each letter.

8. ☐ AD or RM
- ☐ Spouse of AD or RM
- ☐ 1st ☐ 2nd ☐ 3rd ☐ 4th ☐ 5th Child
- ☐ Not Applicable

8. ARE YOU: (Mark ALL applicable categories)

Active Duty or Retired Military

Spouse of Active Duty or Retired Military

1st, 2nd, 3rd, 4th, or 5th child of Active Duty or Retired Military

Not Applicable

9. YOUR SPONSOR'S SOCIAL SECURITY NUMBER OR YOUR SOCIAL SECURITY NUMBER

0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9

9. Print your SSN in the blank boxes. Then fill in the corresponding response box below each number.

- * If ACTIVE DUTY or RETIRED military, enter your SSN
- * If a FAMILY MEMBER OF active duty or retired, enter sponsors SSN
- * For ALL OTHERS, enter your SSN

10. This Health Risk Appraisal is being administered in the following situation:

10. ☐ In-Processing
☐ Periodic Physical Examination
☐ Pre-Physical Fitness Test
☐ Occupational Health Program
☐ Walk-In
☐ Other

11. Racial/Ethnic Background
Mark the most appropriate category.

11. ☐ American Indian or Alaska Native
☐ Asian/Oriental ☐ White, Hispanic
☐ Black, Hispanic ☐ White, Non-Hispanic
☐ Black Non-Hispanic ☐ Other
☐ Pacific Islander

12. Marital Status.
Mark the most appropriate category.

12. ☐ Married ☐ Separated
☐ Never Married ☐ Widowed
☐ Divorced ☐ Other

13. ☐ MALE ☐ FEMALE

14. Your Age

15. Your Height

16. Your Weight

BEFORE you fill in the response boxes
write age, height, and weight at the
top of the columns.

EXAMPLE:

HEIGHT = 6 feet-0 inches
(Must enter if 0 inches)

HEIGHT	
FEET	INCHES
6	0
4	
5	1
	2
7	3

14.

AGE YEARS	
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	
9	

15.

HEIGHT	
FEET	INCHES
4	0
5	1
6	2
7	3
4	4
5	5
6	6
7	7
8	
9	
10	
11	

16.

WEIGHT POUNDS		
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

17. What is your Body Frame Size?

17.

- ☐ Small
☐ Medium
☐ Large

18. How often do you do exercises that improve muscle strength, such as pushups, situps, weight lifting, a Nautilus/Universal workout, resistance training, etc...?

18.

- ☐ 3 or more times a week
☐ 1 or 2 times a week
☐ Rarely or never

19. How often do you do at least 20 minutes of non-stop aerobic activity (vigorous exercise that greatly increases your breathing and heart rate such as running, fast walking, biking, swimming, rowing, etc...)?

19.

- ☐ 3 or more times a week
☐ 1 or 2 times a week
☐ Rarely or never

20. How often do you eat high fiber foods such as whole grain breads, cereals, bran, raw fruit, or raw vegetables?

20. ☐ At every meal
☐ Daily
☐ 3-5 days a week
☐ Less than 3 days a week
☐ Rarely or never

21. How often do you eat foods high in saturated fats such as beef, hamburger, pork, sausage, butter, whole milk, cheese, etc...?

21. ☐ At every meal
☐ Daily
☐ 3-5 days a week
☐ Less than 3 days a week
☐ Rarely or never

22. Do you usually salt your food before tasting?

22.

- ☐ YES ☐ NO

23	CAR/YRK/VAN	23	MOTORCYCLE
a.		b.	
	000		000
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

23.a. In the next 12 months how many thousands of miles will you travel by car, truck or van?

23.b. In the next 12 months how many thousands of miles will you travel by motorcycle?

NOTE: U.S. average for cars is 10,000 miles

24. ☐ Walk ☐ Sub/Compact Car ☐ Truck/Van
☐ Bike ☐ Mid or Full Car ☐ Stay at Home
☐ Motorcycle ☐ Bus/Subway/Train

24. On a typical day how do you usually travel?
(Mark only one)

25.

0	1
0	1 2 3 4 5 6 7 8 9
0	1 2 3 4 5 6 7 8 9

25. What percent of the time do you usually buckle your safety belt when driving or riding?

EXAMPLE: 50%

0	1
5	0 1 2 3 4 5 6 7 8 9
0	1 2 3 4 5 6 7 8 9

26. ☐ Within 5 MPH of limit ☐ 11-15 MPH Over
☐ 6-10 MPH Over ☐ More than 15 MPH Over
☐ Don't Drive

26. On the average, how close to the speed limit do you usually drive?

27. NO. OF TIMES

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

28. NO. OF DRINKS

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

27. How many times in the last month did you drive or ride when the driver had perhaps too much alcohol to drink?

28. How many drinks of alcoholic beverages do you have in a typical week?

NOTE:

1 Drink = 1 glass of wine or wine cooler = 1 can of beer = 1 shot of liquor = 1 mixed drink.

EXAMPLE: 2 DRINKS

0	2
0	0
1	1
2	2

29. ☐ Yes ☐ No
30. ☐ Yes ☐ No
31. ☐ Yes ☐ No
32. ☐ Yes ☐ No

29. Have you ever felt you should cut down on your drinking?
30. Have people ever annoyed you by criticizing your drinking?
31. Have you ever felt bad or guilty about your drinking?
32. Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover (eye opener)?
33. Do your friends ever worry about your drinking?
34. Have you ever had a drinking problem?
35. Have you ever been told that you have diabetes (or sugar diabetes)?
36. Are you now taking medicine for high blood pressure?
37. How often do you eat two well-balanced meals per day?

33. ☐ Yes ☐ No
34. ☐ Yes ☐ No
35. ☐ Yes ☐ No
36. ☐ Yes ☐ No
37. ☐ Daily or almost daily
☐ 3 to 5 days a week
☐ Less than 3 days a week
☐ Rarely or never

38. ☐ Daily or almost daily
☐ 3 to 5 days a week
☐ Less than 3 days a week
☐ Rarely or never

38. How often do you eat foods high in salt or sodium such as cold cuts, bacon, canned soups, potato chips, etc...?

39. ☐ Not Satisfied ☐ Somewhat Satisfied ☐ Mostly Satisfied ☐ Totally Satisfied ☐ Not Applicable

39. I am satisfied with my present job assignment and unit.

40. ☐ Money ☐ Supervisor ☐ No Problem
☐ Social Life ☐ Job
☐ Family ☐ Health

40. What causes the biggest problem in your life?

<p>41. In the last year, how many serious personal losses or difficult problems have you had to handle (example, promotion passover, divorce/separation, legal or disciplinary action, bankruptcy, death of someone close, serious illness/injury of a loved one, etc.)?</p>	<p>41. <input type="checkbox"/> Several <input type="checkbox"/> Few <input type="checkbox"/> Some <input type="checkbox"/> None</p>																																																															
<p>42. In general, how satisfied are you with your life (e.g., work situation, social activity, accomplishing what you set out to do)?</p>	<p>42. <input type="checkbox"/> Not Satisfied <input type="checkbox"/> Somewhat Satisfied <input type="checkbox"/> Mostly Satisfied <input type="checkbox"/> Totally Satisfied</p>																																																															
<p>43. How often are there people available that you can turn to for support in bad moments or illness?</p>	<p>43. <input type="checkbox"/> Never <input type="checkbox"/> Hardly Ever <input type="checkbox"/> Sometimes <input type="checkbox"/> Always</p>																																																															
<p>44. How many hours of sleep do you usually get at night?</p>	<p>44. <input type="checkbox"/> 5 Hours or less <input type="checkbox"/> 6-8 Hours <input type="checkbox"/> 9 Hours or more</p>																																																															
<p>45. Have you seriously considered suicide within the last two years?</p>	<p>45. <input type="checkbox"/> Yes <input type="checkbox"/> Yes, within the last year <input type="checkbox"/> Yes, within the last 2 months <input type="checkbox"/> No</p>																																																															
<p>46. How often do you have any serious problems dealing with your husband or wife, parents, friends or with your children?</p>	<p>46. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>47. How often did you experience a major pleasant change in the past year? (for example, promotion, marriage, birth, award, etc.)?</p>	<p>47. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>48. How often has life been so overwhelming in the last year that you seriously considered hurting yourself?</p>	<p>48. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>49. In the past year, how often have you experienced repeated or long periods of depression?</p>	<p>49. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>50. In the past year, how often have your worries interfered with your daily life?</p>	<p>50. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>51. How often are you able to find times to relax?</p>	<p>51. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>52. How often do you feel that your present work situation is putting you under too much stress?</p>	<p>52. <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Seldom <input type="checkbox"/> Never</p>																																																															
<p>TOBACCO USE HISTORY</p>																																																																
<p>53. How many cigars do you usually smoke per day?</p>	<p>53. <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10</p>																																																															
<p>54. How many pipes of tobacco do you usually smoke per day?</p>	<p>54. <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10</p>																																																															
<p>55. How many times per day do you usually use smokeless tobacco? (Chewing tobacco, snuff, pouches, etc.)</p>	<p>55. <input type="checkbox"/> 0 <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9</p>																																																															
<p>EXAMPLE: 20 times</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td><input type="checkbox"/> 0</td><td><input type="checkbox"/> 1</td><td><input checked="" type="checkbox"/> 2</td><td><input type="checkbox"/> 3</td><td><input type="checkbox"/> 4</td><td><input type="checkbox"/> 5</td><td><input type="checkbox"/> 6</td><td><input type="checkbox"/> 7</td><td><input type="checkbox"/> 8</td><td><input type="checkbox"/> 9</td> </tr> <tr> <td><input type="checkbox"/> 10</td><td><input type="checkbox"/> 11</td><td><input type="checkbox"/> 12</td><td><input type="checkbox"/> 13</td><td><input type="checkbox"/> 14</td><td><input type="checkbox"/> 15</td><td><input type="checkbox"/> 16</td><td><input type="checkbox"/> 17</td><td><input type="checkbox"/> 18</td><td><input type="checkbox"/> 19</td> </tr> </table>		<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6	<input type="checkbox"/> 7	<input type="checkbox"/> 8	<input type="checkbox"/> 9	<input type="checkbox"/> 10	<input type="checkbox"/> 11	<input type="checkbox"/> 12	<input type="checkbox"/> 13	<input type="checkbox"/> 14	<input type="checkbox"/> 15	<input type="checkbox"/> 16	<input type="checkbox"/> 17	<input type="checkbox"/> 18	<input type="checkbox"/> 19																																											
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<p>56. CIGARETTE SMOKING</p>																																																																
<p>How would you describe your cigarette smoking habits?</p>	<p>56. <input type="checkbox"/> Never Smoked (SKIP TO QUESTION 58) <input type="checkbox"/> Current Smoker <input type="checkbox"/> Ex-Smoker</p>																																																															
<p>57. STILL SMOKE</p>	<p>57. a. USED TO SMOKE</p>																																																															
<p>a. How many cigarettes a day do you smoke?</p>	<p>b. How many years has it been since you smoked cigarettes fairly regularly?</p>																																																															
<p>c. What was the average number of cigarettes you smoked per day during the two years before you quit?</p>	<p>57. a. NUMBER b. YEARS c. AVERAGE</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td></tr> </table> </td> <td style="width: 33%; text-align: center;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td></tr> </table> </td> <td style="width: 33%; text-align: center;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td></tr> </table> </td> </tr> </table>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td></tr> </table>	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td></tr> </table>	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>2</td></tr> <tr><td>3</td><td>3</td></tr> <tr><td>4</td><td>4</td></tr> <tr><td>5</td><td>5</td></tr> <tr><td>6</td><td>6</td></tr> <tr><td>7</td><td>7</td></tr> <tr><td>8</td><td>8</td></tr> <tr><td>9</td><td>9</td></tr> </table>	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9
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<p>58. About how long has it been since you had a rectal exam?</p>																																																																
<p>58. <input type="checkbox"/> Less than 1 year <input type="checkbox"/> 1 year <input type="checkbox"/> 2 years <input type="checkbox"/> 3 or more years <input type="checkbox"/> Never</p>																																																																
<p>59. When was the last time you visited the dental clinic for a check-up?</p>																																																																
<p>59. <input type="checkbox"/> Within the last year <input type="checkbox"/> Between one and two years ago <input type="checkbox"/> Over two years ago</p>																																																																

60. At what age did you have your first menstrual period?
61. How old were you when your first child was born?
62. How long has it been since your last breast X-ray (Mammogram)?
63. How many women in your natural family (mother and sisters only) have had breast cancer?
64. Have you had a hysterectomy operation? (removal of the uterus)
65. How long has it been since you had a pap smear for cancer?
66. How often do you examine your breasts for lumps?
67. About how long has it been since you had your breasts examined by a physician or nurse?

68. About how long has it been since you had a prostate (rectal) exam?
69. How often do you do a testicular (sex organs) self exam?

Questions 70 - 75 should be completed by MEDICAL PERSONNEL ONLY.
70. Blood Lipids Total Cholesterol (mg/dl)
71. Blood Lipids HDL Cholesterol (mg/dl)
72. Blood Glucose 12 Hr. Fasting (mg %)
73. Blood Pressure (Systolic)
74. Blood Pressure (Diastolic)

75. Most recent electrocardiogram results.
X1.
X2.
X3.
X4.
X5.
X6.
X7.
X8.